

# WHAT COUNTS IN ECONOMIC EVALUATIONS IN HEALTH?

## BENEFIT-COST ANALYSIS COMPARED TO OTHER FORMS OF ECONOMIC EVALUATIONS



Jeremy A. Lauer  
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World Health  
Organization

The first business of every theory is to clear up conceptions and ideas which have been jumbled together, and, we may say, entangled and confused; and only when a right understanding is established as to names and conceptions can we hope to progress with clearness and facility, and be certain that author and reader will always see things from the same point of view. (von Clausewitz)

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# EXECUTIVE SUMMARY

Economic evaluations in health (EEHs) take many forms. However, they generally involve a comparison of inputs and outcomes, either of which may or may not be market-traded goods.

We call a particular choice of inputs and outcomes a ‘table of accounts’. We argue that the notion of a table of accounts provides a useful way to understand the methodological diversity of EEHs, which subsumes more established but also more restrictive terminology (e.g. the notion of ‘study perspective’).

Our concept of a table of accounts can also be thought of as a more structured

and theoretically grounded instance of the currently popular notion of ‘value frameworks’. We present tables of account for a number of commonly used EEHs, then we discuss at length benefit-cost analysis (BCA), a distinctive form of EEH that has recently attracted substantial attention.

In addition to the table of accounts, a BCA also relies on a table of values: understanding the table of values is key to understanding both the appeal of BCA and also its vulnerabilities.

We conclude with reflections on when and for whom BCA may be an attractive form of analysis compared with other forms of EEH, such as cost-effectiveness analysis.



# 1. BACKGROUND

Improvements in medical technology and an ageing global population mean that healthcare has a greater role in securing human well-being, and also a greater economic footprint, now than at any previous time in history. In many countries, as well as at the international level, those responsible for providing and paying for health services explicitly recognize that not all effective medical technologies and services are affordable. Decisions about whether to adopt technologies and services in publicly funded benefit packages, for example, typically involve balancing health gains against the other socially valuable uses to which the resources required could be put (opportunity cost). This is done increasingly explicitly, on the basis of analyses that build upwards from the biomedical evidence to create nested sets of information that support decision makers in coming to judgements about value for money in health. Any such type of analysis is what we call an economic evaluation in health (EEH).

## INTRODUCTION

Economic evaluations in health are related to the broader domains of planning, management, and evaluation science, which for our purposes explicitly include project evaluation [1], impact assessment for development (now usually called ‘theory of change’) [2], results-based management [3], but also – somewhat farther afield – realist evaluation [4]. Except when distinctions are important, we loosely refer to these and related disciplines with the umbrella term ‘management science’. Evaluations in health share significant

common points with management science and increasingly share a common terminology. Not surprisingly, economic evaluations have also been much influenced by the methods and theories of economics, and in particular by the work of two influential post-war women economists, Dorothy Rice and Selma Mushkin [5, 6, 7, 8]. The post-war context was important for economic evaluations for at least three reasons.

First, the war spurred technological and social advancement and, as a result, sharpened awareness of the need to plan, conduct and evaluate large-scale collective undertakings, such as warfare. In this sense, the roots of modern management science go back at least as far as the revolution in military theory and practice begun in 19<sup>th</sup> century Prussia through the work of career soldiers Carl von Clausewitz and Helmuth von Moltke who, drawing lessons from the Napoleonic Wars, formulated and tested new theories of war, of which modern management science happens to be a direct descendant. These writers introduced conceptual innovations that are still highly salient for management science: a distinction between levels of result (for example, outputs, outcomes and impact) and an explicit recognition of the role of uncertainty and feedback effects in the prosecution of complex plans.

The second reason is that the war coincided with a massive growth in the role of the state in the former warring countries and the concomitant expansion, in the West, of direct taxation (e.g. income taxes) as a primary means of financing public budgets.

As a result, in the post-war period the public sector achieved a new prominence – one that had hitherto been inconceivable – in the lives of the citizens of these countries. These two features (the development of management science as an extension of the theory of war and an unprecedented expansion of the public sphere) together formed the basis of the modern, technocratic approach to public governance, within which management science remains a determining element.

The third reason is that the period immediately before, during, and after the Second World War corresponded with the entry of economics (and economists) for the first time in history into the highest spheres of public policy, as exemplified by the work and lives of John Maynard Keynes in the United Kingdom of Great Britain and Northern Ireland and John Kenneth Galbraith in the United States of America. Ever since, and regardless of the political allegiances of influential economists, economics has maintained a dominant role [9] in public policy and administration, explaining in part the overwhelming importance of economic ideas and theories within management science. In other words, since the post-war period both the objectives and results of collective social undertakings, public and private, have generally and wherever possible been conceptualized, measured and evaluated in economic terms.

## CONTEXT

Globally, health systems are diverse, with varying institutional arrangements and stakeholder constellations. Nevertheless, the hitherto predominant form of EEH, cost-effectiveness analysis (CEA), was developed and refined in response to the demands of particular settings during the latter half of

the 20<sup>th</sup> century, namely those of the health services in the United States, Canada and England. A selection of foundational pieces is given here [10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21]; later consolidations are cited here [22, 23, 24, 25, 26, 27]. For the reasons mentioned in the preceding section, there was an evident perception by decision-makers in those settings of a duty to improve population health through the regulation, financing, or direct oversight of health services. Indeed, the 1980 report of the Office of Technology Assessment of the United States Congress cites over 650 applications of economic analysis to healthcare, virtually all done during the 1970s, a substantial minority of which were published by government agencies [22].

Subsequently, in the early years of the 21<sup>st</sup> century, staff at the Secretariat of the World Health Organization, and others, became interested in applying the methods of CEA to health problems in developing countries [27], and hundreds of applications of economic analysis to global health have since appeared. Far from waning, the interest in evaluating health programmes in developing countries with respect to delivering value for money has become even more evident recently, with, among other developments, the founding of the *International Decision Support Initiative* [28], and important innovations in the use of CEA by a variety of domestic stakeholders and decision-makers in both developing and emerging economies [29, 30, 31, 32]. These latter contributions, in particular, renew the impetus to develop a new understanding of the method and practice of economic evaluation, one that is fit for purpose for current problems in global health. An example of this kind of thought development is [33]; the present extended essay is a further extension and crystallization of the research insights contained in [29, 30, 31, 32].

The technical basis of EEHs has accordingly evolved in response to the challenges of supporting decision-making in varying jurisdictions. The principal emerging trend, however, has been that non-economists, in particular, members of the diverse professional communities active in global health, international health, and public health [34], including policy makers, ethicists, political representatives, researchers, project managers, donors, health technical experts, and programme specialists – as well as health economists – have recently been citing, using, commissioning and conducting EEHs. Although on the one hand a mere extension of post-war trends within management science, this recent development nevertheless represents a striking demoticization of economics within the field of health: it is now safe to say that EEHs are no longer the privileged domain of specialist technocrats. A new trans- (and not merely multi-) discipline is thus emerging.

To bridge gaps in understanding across a diversity of audiences, where participants struggle with familiar words being used in unfamiliar ways, in this paper we offer a unified framework for thinking about the forms that EEHs may take. Copious technical information is available elsewhere about the methods of EEHs, most of which has been consolidated in the references [22, 23, 24, 25, 26, 27]. Here we propose merely to organize the concepts of EEHs in a way that should be understandable by and acceptable to health economists as well as to members of other professional communities and which, in addition, provides insights into controversies and points of confusion that have bedevilled specialists and non-specialists alike. Specifically, we discuss the pros and cons of benefit-cost analysis and in particular one sub-type of benefit-cost analysis (“the

investment case”) that is currently popular in the global health economics literature.

Our survey is limited in scope: study types that we do not address in detail are described in the next section.

## EXCLUDED TYPES OF ANALYSIS

### MCDA AND PROCEDURAL DECISION AIDS

We do not discuss methods based on multi-criteria decision analysis (MCDA), although these have also recently been popular. MCDA, in our understanding, rests on a different philosophical foundation from that of the main streams in economic evaluation. The methods of EEH discussed here fix their principal roots in *consequentialism*<sup>1</sup>, namely, the ethical theory that actions can and should be judged solely by their outcomes, or consequences. Implicit in this orientation is the claim that causal modelling, such as logical framework analysis [1] or randomized controlled trials, can capture and organize knowledge about states of the world in ways that are relevant for decision-making.

MCDA methods, on the other hand, are based on *proceduralism*, a rules-based conception of decision-making according to which decisions are only partially (if at all) justified with reference to the goals stakeholders may have regarding outcomes, but where it is held that descriptive modelling (e.g. ‘deliberative discourse’) can structure and make explicit the reasons for actors’ decisions, thereby

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1 <https://plato.stanford.edu/entries/consequentialism/>. While non-consequentialist accounts of EEH are possible, we believe they shed less light.

establishing the possibility of ‘accountability for reasonableness’ [35].

These are stylized distinctions. The frameworks we present are intended as ways of organizing conversations about different forms of causal EEHs; they are less useful for conversations about MCDA or other proceduralist methods. Nonetheless, we believe that MCDA and similar proceduralist approaches can support in a powerful way the institutional and political context in which decisions are made. For example, they help in promoting the public and professional credibility of EEHs and are, to that extent, highly complementary to consequentialist methods. Although our main business here is with consequentialist EEHs, our overall view is that hybrid approaches in which institutional, legal, and other procedural values supervene on a set of core consequentialist concerns appear very promising.<sup>2</sup>

## VALUE FRAMEWORKS AND VALUE PROPOSITIONS

Another idea which has lately become popular is the *value framework* [36]. More than two dozen value frameworks, some of which are explicitly advocacy-oriented, have been proposed in recent years, for example for cancer drugs, vaccines and medical devices [Table 1, 36]. *The International Society for Pharmacoeconomics and Outcomes Research* (ISPOR) recently concluded a review of such value frameworks with a caution [36]:

*[T]hese ... frameworks ... raise important questions and potential concerns. ... [I]t is essential to scrutinize whether the frameworks use approaches that are transparent as well*

*as conceptually and methodologically sound. By attempting to simplify the problem of value assessment, these new frameworks could end up making ad hoc assumptions and simplifications not supported by theory or evidence....*

ISPOR’s review [37], which was arguably intended to lend structure to a chaotic discourse, has nevertheless been criticized both by health economists [38] and patient representatives [39], though apparently welcomed by industry stakeholders [40].

Similarly, the term *value proposition* is now being adopted in health. Value propositions were originally conceived of as one of the core functions of a business model, namely, “to articulate ... the value created for users by the offering based on the technology” [41]. At least in the sense of [41], a value proposition is necessarily, albeit often only implicitly, expressed in the mere embodiment of a technology in a product. However, the notion of value propositions is now proposed as a conceptual model useful for clarifying how incentives faced by stakeholders on the supply side (investors, managers, and innovators) and the demand side (purchasers, regulators, and policy-makers) facilitate (or interfere with) the development of effective medicines and vaccines for use in global health. Formulating and comparing explicit value propositions has been proposed as a tool for understanding how diverse actors might better align, so that coordination problems can be explicitly managed [42, 43, 44, 45].

Although they share some properties with EEHs, value propositions and value frameworks should not be understood as belonging to the family of evaluation research methods we discuss here. Rather, they can be understood as useful tools for rendering explicit (and hence auditable) the

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2 A familiar example of such a hybrid approach is health technology assessment, such as exemplified by NICE or HITAP, where an EEH is usually just one input (and perhaps merely a heuristic aid) to a decision-making process.

transactional interests of diverse actors. In this, they definitely belong to the broader domain of management science. Notwithstanding their usefulness for clarifying, for example, the diverse incentives faced by entrepreneurs, investors, manufacturers, regulators, purchasers, providers, consumers – or by the representatives of such groups – value propositions and value frameworks are in our view not, at least without substantial modification, suitable for use as decision-making tools in public policy. Indeed, writing for ISPOR, Neumann et al. note that the emergence of value frameworks in the United States private sector can largely be attributed to the waning role of the public sphere in the largest medical market in the world [36].

We now return to our primary narrative about causal EEHs as technocratic approaches to public-sector decision-making in health.

## OUTLINE

The principal explanatory device we introduce is a *table of accounts*. We use this device in two ways:

- (i) to provide a systematic overview of the most common forms of EEH to be found in the health economics and global health literature; and
- (ii) to structure a commentary on and critique of benefit-cost analysis (BCA), a form of EEH which has been recently advocated by some and criticized by others.

The remainder of the paper is as follows. In Section 2 we define key terms; in Section 3 we lay out and use the table of accounts to compare eight different forms of EEH: effectiveness studies; costing studies; cost-effectiveness studies; distributional cost-effectiveness studies; extended cost-effectiveness studies; cost-of-illness studies; benefit-cost analysis; and the investment case for health, highlighting similarities and differences, thus meeting objective (i). Objective (ii) occupies Section 4 and consists of an extended discussion of benefit-cost analysis as it applies to health using the concept of the table of accounts in conjunction with a related concept that we describe in that section called a *table of values*; Section 5 concludes.

## 2. DEFINING TERMS

The main terms we shall use are defined in Table 1. Some glosses are provided in the text that follows.

**Table 1:** Key definitions of terms as used here, cross-references in the table shown in italics

Term	Definition
Accounting	A system for counting, recording and interpreting debits and credits, usually in a <i>ledger</i> .
Accounting framework	The complete set of criteria affecting what is counted and how it is recorded and interpreted for decision-making in an EEH.
Actions	Human behaviour undertaken with the aim of realizing an <i>intervention</i> , plan, or project. Actions are thus an <i>input</i> .
Benefit	A positive <i>outcome</i> expressed either in natural units (like fewer bed-days) or in constructed units (like QALYs).
Cause	A set of <i>interventions</i> , conditions or actions that reliably produce, or tend to produce, an <i>effect</i> (e.g. "reckless driving causes accidents").
Counterfactual	The state of the world as it would otherwise have been but for a specific <i>intervention</i> .
Effect	Outcomes that are reliably produced, or tend to be produced, by a <i>cause</i> .
Efficiency	A measure of how economically <i>resources</i> produce desired results, usually expressed as a ratio of outcomes to inputs. In economics, an efficient <i>intervention</i> minimizes the cost of attaining a given <i>outcome</i> , alternatively maximizes the <i>benefit</i> for a given cost.
Health	A state pertaining to human beings usually defined, positively, in terms of variables measuring health-related quality of life (e.g. abilities to function, freedom from anxiety or pain) or, negatively, in terms of absences (e.g. of disability).
Healthy life-year	A year of life experienced by a person in perfect health.
Inputs	The <i>resources</i> that are required to perform the <i>intervention</i> or generate an <i>outcome</i> .
Intervention	A set of <i>inputs</i> whose combination in a prescribed way reliably achieves a desired <i>effect</i> ; the intervention causes the desired <i>effect</i> .
Ledger	A repository of <i>accounting</i> information relating to an <i>intervention</i> , plan, or project.
Logical framework	A device (usually tabular) identifying <i>intervention</i> elements (e.g. <i>inputs</i> , <i>actions</i> , <i>outputs</i> , <i>outcomes</i> , impact) and their causal relationships.
Market price	The amount of money for which a <i>resource</i> is traded on the market. Also called market <i>value</i> .
Market traded/non-market traded	<i>Market traded</i> is a term describing <i>resources</i> that can be bought and sold on markets or by means of contracts and whose value is denominated in monetary terms. <i>Non-market traded</i> is a term applied to <i>resources</i> that are not bought or sold with money.
Natural units	The generic name of a <i>resource</i> that is used when counting with the natural numbers (e.g. 2 <u>pencils</u> , 3 <u>hours</u> of labour, 1 <u>electron microscope</u> ) rather than by conversion to a constructed measure (like a QALY) or a common <i>unit of account</i> (e.g. \$1, \$2, \$3, ...).
Opportunity cost	The value of the most highly valued outcome that is forgone in dedicating <i>resources</i> (material or immaterial) to a given course of action.
Outcome	A change in the state of the world, such as the health of an individual or a population resulting from an <i>action</i> or course of action. An outcome is one of the consequences of an action. An outcome can be either positive (good) or negative (bad).



**Table 1: Contd.**

Term	Definition
Output	The product or immediate result of an <i>intervention</i> , plan, or project, usually measured in <i>natural units</i> .
Perspective	In general, the point of view from which a (possibly hypothetical) observer would assess an <i>intervention</i> , plan, or project. Specifically, a summary term expressing what count as debits and credits in the <i>ledger</i> .
Price	The <i>value</i> , usually expressed in monetary <i>units of account</i> (e.g. dollars), of an <i>input</i> , <i>output</i> , <i>outcome</i> or <i>resource</i> .
Resource	An economic (i.e. scarce) good, human, material or immaterial.
Table of accounts	A concise representation of the <i>accounting framework</i> in tabular form.
Unit of account	A unit used for measuring and counting <i>resources</i> (e.g. <i>natural units</i> , monetary units, or constructed measures such as QALYs).
Value/Market value	<i>Value</i> is any measure denoting the relative importance of goods or <i>resources</i> . <i>Market value</i> is the price paid in money for <i>resources</i> (material or immaterial) and <i>outputs</i> on the market.

We say that an economic evaluation is done in *health* when the main outcomes of interest are health outcomes; similarly, when the defining purpose of an intervention is to improve health, we call it a health intervention. In this paper, we mainly leave open the question of which specific health outcomes are of interest. Similarly, we leave open the question of whether the effects of interventions relate to individuals or to whole populations or sub-populations, and of whether the interventions themselves are preventive or restorative or are public-health measures. Naturally, health interventions can have non-health outcomes just as non-health interventions can have health outcomes, and we return to this point in Section 3.

EEHs are inherently comparative. The need to make complex comparisons easier explains the tendency in EEHs to summarize results in a few numbers, since the compression of information facilitates its retention, comparison and communication. The comparisons EEHs propose are numerical: such as “3 is less than 5”, or “3/5 is less than 2/3”. Because the answers are numerical,

one might be tempted to claim that EEHs are mere counting exercises. However, comparisons require common denominators, such as uniform definitions of the cost of inputs, as well as a common unit of account for outcomes, such as health. Before we can compare inputs, outcomes, or their numerical ratios, we first need to count the elements being appraised. All EEHs thus depend at base on an accounting exercise.

## THE LOGICAL FRAMEWORK AND THE CAUSAL STORY

EEHs also rely on a *logical framework* whereby a set of inputs is systematically linked to a set of outcomes. The logical framework may also identify indicators of success or highlight assumptions and risks influencing the outcome. In the logical framework, *inputs* (combined as required in the intervention) can be called *causes* of the outcomes, and the outcomes, *effects* of the inputs. Such a framework is commonly called a *model*.

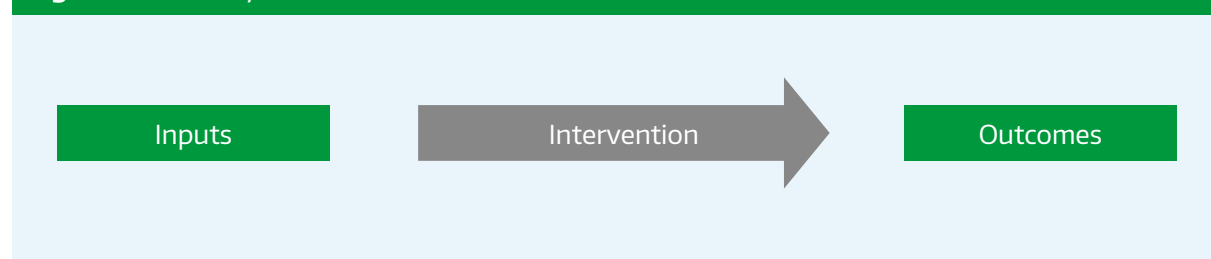
A model encapsulates a (causal) story: “if you do this, then that will result”. This is a useful metaphor since most stories involve a simplification of reality and require the use of imagination on the part of the listener. The basic structure of most intervention stories is shown in Figure 1. In the terminology used here, the decision-maker can be called the **observer**. She is the intended audience of the story, the one for whom the EEH is performed. She may be an actual person (like a minister of health or the senior outcomes manager of a pharmaceutical firm); alternatively, the observer can be a committee that makes decisions or recommendations. Moreover, the observer may occasionally be an hypothetical, legal, or even merely conventional construct (for example “society”, “the health system”, or a particular institution therein); in such cases the “observer” might fairly be called an invention of the analyst. Deciding who is the observer is one of the foundations of any EEH, and it depends on context and circumstances – often the observer is whoever going to pay for the analysis, or the principal represented by the payer. However, it would be a mistake to insist that observers must always be actual agents or their principals.

**Outcomes** describe a change in the state of the world resulting from an **action** or course of action; outcomes provide an aim, or reason, for the action. This is the definition commonly

used in ethics<sup>3</sup>. In health economics and EEHs more generally, however, the outcome usually refers to the impact of the intervention on health (and its distribution). In results-based management, outcomes are understood to be (limited to) the “short-term and medium-term effects” of an intervention’s outputs [3]. This is not the case in an EEH, where the time period considered is customarily determined by the duration over which consequences and costs are expected to accrue. **Outputs** are here used to describe the direct products of an intervention [3], closely related to the way the term is used in production theory: a production process uses inputs to produce outputs; outputs are the immediate result of an intervention, plan, or project. “Patients treated”, “the fraction of population inoculated”, “survey questionnaires delivered” are examples of outputs. Their principal use is for purposes of monitoring, and are often the same as throughputs and other measures of workload. An example of a throughput is “hospital deaths and discharges”. Distinct from other forms of management science, in an EEH the motivational factor is generally the outcome rather than output or throughput.

3 In volume 1 of Derek Parfit’s *On what matters*, the word ‘outcome’ appears nearly 200 times, whereas ‘output’ and ‘impact’ are not used at all.

**Figure 1:** The story of an intervention in schematic form





In succinct terms, EEHs represent a specific table of accounts corresponding to a specific logical framework. In many economic treatises [22, 23, 24, 25, 26, 27], however, the logical framework is only implicit or even not mentioned. This might be one of the reasons that the links of economic evaluation with management science are usually overlooked. Indeed, at least two of the insights explicitly considered central at the birth of management science have since mainly been observed in the breach: i) in economic evaluations it has become usual to elide elements in the results hierarchy, underestimating thereby the dependency of outcomes on intermediate results; ii) in management science more generally (including economic evaluations) it has become commonplace to ignore the fact that project implementation is an interactive process with important feedback effects. Both of these ideas were in the foreground of theories of war; as a more technocratic and economically oriented conception of management science has become dominant, however, those elements deriving from German idealist philosophy have been dropped, leaving only the structures congenial to non-Continental (i.e. analytical) philosophy. That said, the results hierarchy has been resurrected in the form of logical frameworks and related structures that are now considered mainly as of importance in non-economic evaluations such as project evaluation for development; feedback effects, on the other hand, come to the fore in realist evaluations and other derivatives of critical theory<sup>4</sup>. Pure proceduralist forms of evaluations such as MCDA in turn emphasize the fundamental value of respect for human agency and the importance of non-coercive forms of persuasion (“deliberative

discourse”). All of these ideas, including consequentialism, were nevertheless conjoined in the Enlightenment thought of Kant.

## THE TABLE OF ACCOUNTS

To render legible the key features of economic evaluations to non-health economists interested in evaluation science in health, we introduce here the notion of a table of accounts. The **table of accounts** summarizes in a comprehensive yet concise manner what counts and, equally important, how it is interpreted in an EEH. While a great deal of both detail and generality can be derived from the study of a table of accounts, in introducing the concept we intentionally eschew calling attention to a number of features of evaluation studies that are generally considered central in health economics. Some are, however, mentioned in what follows. Our minimalist approach is motivated by the fact that even the closely related disciplines of health economics, benefit-cost analysis and welfare economics each have their own highly idiosyncratic terminology and conceptual framework. Moreover, our primary task is not to describe all the relevant features of any of these study types, but rather to uncover a structure that can serve to unify concepts across these fields while revealing common features and making explicit relevant differences.

First and foremost, our table of accounts distinguishes effects from causes and market from non-market goods. A good table of accounts should also summarize, however, the intervention story, the logical framework, the perspective of the observer, the ethical views of the decision-maker and, as we shall see in Section 3, the specific technical framing

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4 <https://plato.stanford.edu/entries/critical-theory/>.

of the EEH. So the table of accounts encodes not only the information corresponding to items 1–7, 10–13, and 18–22 of the CHEERS checklist [46] but, in addition, captures in summary form the logical framework, the study type and the ethical position. A table of accounts will therefore typically be unique to the application in question. We refer to the table of accounts, when considered together with this broader set of implicit and explicit interpretive information, as an **accounting framework**.

In the form we propose, entries in the table are initially recorded in **natural units** (i.e. quantities or numbers, **Qs**). Moreover, at least at first, it can be convenient to organize entries in terms of generic categories such as those shown in Table 2. As the most important economic features of an EEH can be brought into focus mainly by distinguishing inputs and outcomes that are **market traded** from those that are **non-market traded**, attention to these categories is key.

The table of accounts shown in Table 2 has been constructed with a health intervention in mind, and so is intended to include the typical inputs and outcomes that decision-makers (and technocrats) find important in EEHs. In a table of accounts intended for the

evaluation of a specific health intervention one can replace the generic categories shown here with the names of specific items (e.g. aspirin, exercise and heart attacks avoided).

## UNITS OF ACCOUNT

Using life-years (or **healthy life-years**) to count health outcomes is typical in an EEH, although it is by no means required. Such units are usually called QALYs, DALYs or, occasionally, HALYs. The common basis behind such metrics is the life-table statistic person-years, optionally adjusted by health status. Healthy life-years are thus a (constructed) **unit of account** for measuring different kinds of health outcomes on a comparable scale. Despite the currency of such measures, one should not underestimate the level of effort required to achieve the informational compression entailed in such constructed units of account. The chief advantage of using a constructed unit of account such as HALYs is that it facilitates measurement across diseases and interventions, and also accounts for the benefit of interventions that improve health-related quality of life. But, as we shall see later, comparability and compression can bring a cost in terms of the validity and reliability of a unit of account.

**Table 2:** Generic table of accounts for an EEH of a health intervention (showing typical categories of interest)

	Inputs (Qs)	Outcomes (Qs)
Market-traded inputs and outcomes	<ul style="list-style-type: none"> <li>• Paid work</li> <li>• Equipment and machines</li> <li>• Medicines and consumables</li> <li>• Facilities</li> <li>• Other market-traded inputs</li> </ul>	<ul style="list-style-type: none"> <li>• Increased productivity</li> <li>• Increased labour supply</li> <li>• Other market-traded outcomes (positive or negative)</li> </ul>
Non-market-traded inputs and outcomes	<ul style="list-style-type: none"> <li>• Beneficiaries' unpaid work, e.g. travel and waiting time</li> <li>• Other unpaid work, e.g. family carers' time</li> <li>• Other non-market-traded inputs</li> </ul>	<ul style="list-style-type: none"> <li>• Increased years of life</li> <li>• Increased health-related quality of life</li> <li>• Other non-market-traded outcomes (positive or negative)</li> </ul>

The unit of account invariably used to count inputs in an EEH is **price** (*P*). In addition to providing a common metric for aggregating and summarizing inputs, prices have the additional property of measuring **value**, so for this reason we call any 2-by-2 table of prices corresponding to a given table of accounts the **table of values**. **Market prices**

are at first glance just the quantity of money required to purchase a given resource on the market instead of using the money to buy some other thing. The **opportunity cost**, however, represents the value of the *most valued* forgone alternative, so market prices will not always correspond to the opportunity cost.

# 3. A FRAMEWORK FOR THINKING ABOUT ECONOMIC EVALUATIONS IN HEALTH

We now consider some of the different technical framings of EEHs, specifically: effectiveness studies; costing studies; cost-effectiveness studies; distributional cost-effectiveness studies; extended cost-effectiveness studies; benefit-cost analysis; cost-of-illness studies; and the investment case.

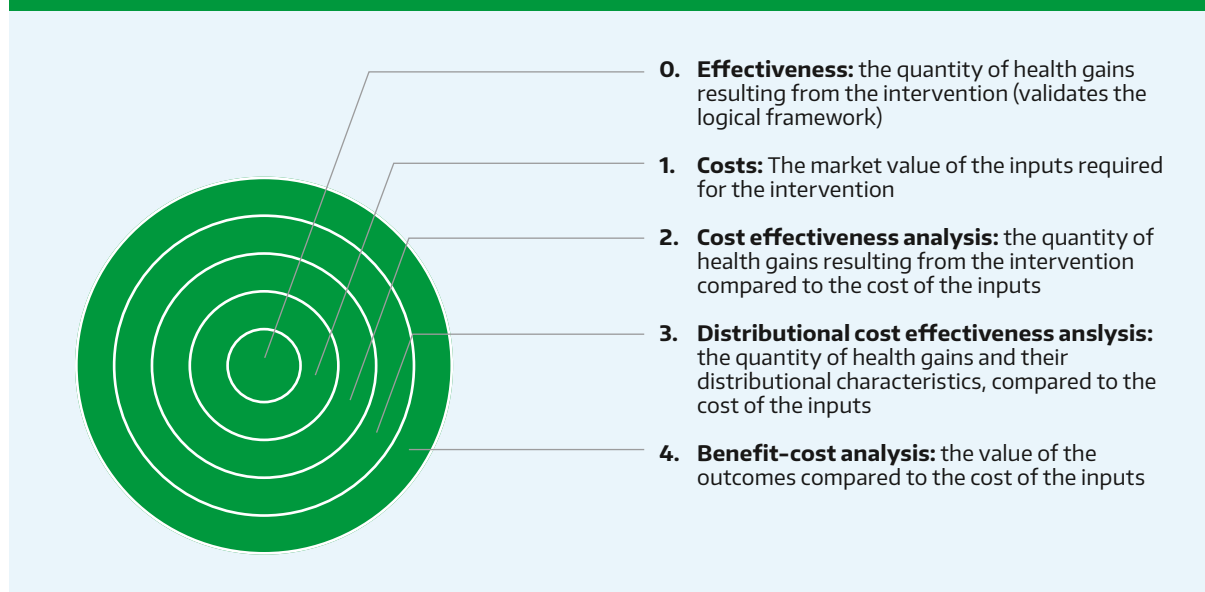
## EFFECTIVENESS STUDIES

The EEH on which all the others are built is the effectiveness study. An effectiveness study constitutes an evaluation of the logical framework, that is, it determines whether the inputs reliably produce the outcomes when combined as stipulated in the intervention. This kind of study is common in medicine and public health (e.g. in the form of trials), and so descriptive accuracy would recognize epidemiology as the framing discipline of the effectiveness study. Nonetheless, since all EEHs depend upon evidence of effectiveness, the effectiveness study is an essential building block for any economic evaluation. The “effectiveness study” relied upon in a given EEH may in fact involve the synthesis of evidence from multiple trials or other sources. Such synthesis, when required, is represented in the logical framework. Though we do not discuss evidence synthesis in more detail, this seems like a good place to remind readers that EEHs are inherently trans-disciplinary exercises, typically relying on, according to context and purpose, epidemiology, biostatistics, evidence review, economics, econometrics, dynamical modelling, and

demography, as well as from political science, management science, and ethics. In view of their primacy, we label effectiveness studies as the level-0 EEH.

EEHs display a nested structure in the sense that the different study types can be arranged in layers such that the outer rings require incrementally greater amounts of information, building on that contained in the inner studies. Our device of concentric rings involves a certain amount of simplification. That said, it is always applicable in the sense that, logically if not temporally, we need to start in the centre (i.e. we need to have on hand the required information from the effectiveness study). Once this information is established, the order of the other studies described in the outer rings can be somewhat arbitrary and ought not to be seen as rigidly linear. Indeed, if evidence from an appropriate effectiveness study is on hand, it can be possible to jump over certain rings directly to the more outward layers. There is, however, merit in emphasizing the nested structure: doing so not only provides an effective didactic device but also highlights the possibility (central, moreover, to our pluralistic approach) of presenting the same underlying set of information in various technical framings. In other words, we believe that a wisely constructed EEH can exploit the nested structure we describe so as to communicate the same results more effectively to different observers. See Figure 2 for a picture of how different EEHs build outwards from the effectiveness study.

**Figure 2:** EEHs have a nested structure



## COSTING STUDIES

Costing studies are the level-1 EEH and merely associate prices to quantities identified in a prior effectiveness study. The common unit of account used in costing studies is market prices ( $P_s$ ). To calculate **costs**  $\equiv P_{inputs} \times Q_{inputs}$  we multiply the unit price for each input by the number of units of input used and then sum across all inputs. If the market does its job well (more on this in Section 4), then costs represent the **opportunity cost** (see Table 1) of resources. Even if there are distortions, though, costs calculated using market prices are still (implicitly) understood

by the practitioners of costing studies to be a useful estimator of economic opportunity cost.

An example table of accounts for a costing study is shown in Table 3.

Here we show non-market-valued costs as “not assessed in this example”, meaning that their absence is not a feature of costing studies *per se* but merely of this particular table of accounts. The omission of non-market-valued costs implies that the perspective of the table of accounts might be called financial. In practice, users of costing studies typically

**Table 3:** Generic table of accounts for a typical costing study in health

	Costs ( $P_s \times Q_s$ )	Outcomes ( $Q_s$ )
Market-valued costs	<ul style="list-style-type: none"> <li>• Paid-work costs</li> <li>• Equipment-and-machines costs</li> <li>• Medicines-and-consumables costs</li> <li>• Facilities costs</li> <li>• Other market-traded costs</li> </ul>	(not assessed)
Non-market-valued costs	(not assessed in this example)	(not assessed)

care mainly about market-valued costs, but there is nothing in principle to discourage someone who is doing a costing study from counting non-market-valued costs, in which case the costing study might be said to have an economic or societal (or some other) perspective depending on what is considered important for the observer. However, as non-market-traded inputs do not have market prices, estimates of their value (price) need to come from special calculations. We discuss such calculations in Section 4.

## COST-EFFECTIVENESS STUDIES

The next ring in the nest relates to cost-effectiveness analysis (CEA). An example of a generic table of accounts for CEA is shown in Table 4. The defining characteristic of a typical CEA is that it measures inputs in terms of a common unit of account (money) but measures outcomes as quantities (using either natural or constructed units). A separate point is that, at least for EEHs, health outcomes are usually the defining purpose of the intervention evaluated with a CEA. Thus, whether the upper-right cell (representing market-traded outcomes) is populated, and with what elements, is primarily a contextual consideration that depends on the purpose and audience of the study. There is no reason

of principle why a CEA should not consider non-health consequences, and some do. That said, our narrative focuses on the kind of CEA that compares costs (whether market- or non-market traded) to health outcomes.

## DISTRIBUTIONAL COST-EFFECTIVENESS STUDY

The next level shows distributional cost-effectiveness analysis (DCEA). A DCEA uses nearly the same table of accounts as a CEA but includes in addition at least one non-market-traded outcome representing the distribution of health gains (see Table 5). The distribution of outcomes (and also of opportunities) is an ethical concern often referred to under the heading of equity, although the related concepts of justice, equality, and fairness are also germane. In contrast to classic utilitarianism, these distributional concepts all make some claim to the effect that differences between persons matter because people have different moral claims on resources [47]. Although the equality of outcomes can usually be measured in terms of the simple statistical dispersion of the outcome in the population of interest, equity, fairness, and justice each require, though potentially in different ways, more than a simple statistical measure; they require an account linking purely descriptive statistics

**Table 4:** Generic table of accounts for a typical CEA in health

	Costs ( $P_s \times Q_s$ )	Outcomes ( $Q_s$ )
Market-valued costs and market-traded outcomes	<ul style="list-style-type: none"> <li>• Paid-work costs</li> <li>• Equipment-and-machines costs</li> <li>• Medicines-and-consumables costs</li> <li>• Facilities costs</li> <li>• Other market-traded costs</li> </ul>	(for simplicity, not shown in this example)
Non-market-valued costs and non-market-traded outcomes	<ul style="list-style-type: none"> <li>• Beneficiaries' unpaid-work costs</li> <li>• Other unpaid-work costs</li> <li>• Other non-market-traded input costs</li> </ul>	<ul style="list-style-type: none"> <li>• Increased years of life</li> <li>• Increased health-related quality of life</li> </ul>

with some normative ethical account. Though DCEA has not so far elaborated a theory of equity, its leading practitioners do not tend to favour the use of raw equality metrics [48], preferring the decision-maker's preferences about differing moral claims to be explicitly represented in terms of trade-offs between the distribution and the maximization of health. Thus, a typical DCEA converts health outcomes (measured in HALYs) into "equity-equivalent health outcomes" (also measured in HALYs) by means of a rate of exchange determined by (some observer's) preferences regarding health–equity trade-offs. The rate of exchange might come from social preferences if they are known, but the key objective of DCEA is to make such trade-offs explicit. Finally, insofar as DCEA requires an aggregation structure for valuing both the distribution and the maximization of health

it is similar to the social-welfare-function approach [47].

## EXTENDED COST-EFFECTIVENESS ANALYSIS

Extended cost-effectiveness analysis (ECEA) is, as its name implies, a study type measuring and reporting a potentially open-ended number of outcomes in addition to health and equity, such as financial risk protection, but also budget impact, acceptability to the target population, and feasibility (i.e. the probability of successful implementation). In contrast to DCEAs, however, the trend of practice in ECEAs is to report outcomes in disaggregated fashion, displaying them dashboard style, rather than using a common unit of account for the aggregation of quantities of interest in a single statistic. See Table 6.

**Table 5:** Generic table of accounts for a typical DCEA in health (additions shown in bold type)

	Costs ( $P_s \times Q_s$ )	Outcomes ( $Q_s$ )
Market-valued costs and market-traded outcomes	<ul style="list-style-type: none"> <li>• Paid-work costs</li> <li>• Equipment-and-machines costs</li> <li>• Medicines-and-consumables costs</li> <li>• Facilities costs</li> <li>• Other market-traded costs</li> </ul>	(for simplicity, not shown in this example)
Non-market-valued costs and non-market-traded outcomes	(for simplicity, not shown in this example)	<ul style="list-style-type: none"> <li>• Increased years of life</li> <li>• Increased health-related quality of life</li> <li>• <b>Equity-equivalent healthy life years (positive or negative)</b></li> </ul>

**Table 6:** Generic table of accounts for a typical ECEA in health (additions shown in bold typ)

	Costs ( $P_s \times Q_s$ )	Outcomes ( $Q_s$ )
Market-valued costs and market-traded outcomes	<ul style="list-style-type: none"> <li>• Paid-work costs</li> <li>• Equipment-and-machines costs</li> <li>• Medicines-and-consumables costs</li> <li>• Facilities costs</li> <li>• Other market-traded costs</li> </ul>	(for simplicity, not shown in this example)
Non-market-valued costs and non-market-traded outcomes	(for simplicity, not shown in this example)	<ul style="list-style-type: none"> <li>• Increased years of life</li> <li>• Increased health-related quality of life</li> <li>• <b>Equity (usually shown indirectly by the stratification of outcomes by population covariates)</b></li> <li>• <b>Financial risk protection (usually shown by cases of poverty averted)</b></li> </ul>



## AGGREGATION IN EEHS

ECEA poses an implicit question: If, as in costing studies and CEAs, we can measure the value of inputs using a common unit of account (money), then why not also measure the value of outcomes with a common unit? This question runs like a red thread through all the EEHs discussed here, with many of the decisions that appear to be about technical framing in fact representing an underlying ethical view about the benefits or disbenefits of aggregation. The typical CEA has already made a significant step in the direction of aggregation by measuring disparate health outcomes with a common unit such as HALYs. DCEA has made a further step in proposing to measure both the distribution and maximization of health with the same unit (e.g. equity-equivalent HALYs); similarly, it was initially proposed that ECEA would account for the money-metric value of insurance among its outcomes [49], which is nothing other than a way of converting financial risk protection into income-equivalent dollars. So there is a clear tendency in EEHs to use a common unit of account.

HALYs, equity-equivalent HALYs, and the money-metric value of financial risk protection all require special calculations to measure outcomes with a common unit of account. These calculations are not only technically challenging but are also often hard to explain to decision-makers or the public. The trouble they cause nevertheless brings several advantages, for example:

1. achieving informational compression for disparate outcome measures that are measured using distinct natural or constructed units.

As just mentioned, a common unit of account also opens up, at least in principle, the possibility of:

2. measuring both inputs and outcomes using the same units.

Moreover, when the common unit of account for outcomes is monetary, then it provides the further possibility of:

3. aggregating market-traded outcomes (e.g. upper-right cell) with non-market-traded outcomes using prices.

The latter point might be considered important when health interventions have important non-health outcomes, some of which are market traded. Moreover, many non-health interventions in public policy, such as changes in the money supply, frequently have market-traded non-health outcomes, such as increasing employment, as one of their defining purposes. So measuring non-market-traded outcomes using prices not only allows for the inclusion of a larger scope of outcomes (some of which may be relevant for ethical reasons or because they have health consequences) but it also allows for the comparison of health interventions and non-health interventions using the same metric. These considerations bring us naturally to the next study type.

## BENEFIT-COST ANALYSIS

Despite the similarities in their table of accounts, a BCA proposes to do something more than a CEA, which might otherwise count the very same kinds of inputs and outcomes. This extra something amounts to valuing *all* inputs and outcomes in terms of a



common unit of account, namely money. So here we introduce another term, one that is idiosyncratic to the BCA: when outcomes are valued in terms of money, a BCA calls them **benefits**  $\equiv P_{outcomes} \times Q_{outcomes}$ . In this sense, specific to this particular study type, benefits estimate the value of outcomes. When other study types measure outcomes in terms of non-monetary units, either natural or constructed, in technical discussions at any rate they are typically referred to simply as outcomes, outputs, impacts, or effects (hence the term cost-effectiveness). Others, for example, those who work on healthcare insurance packages, use “benefit” to describe the specific services to which a beneficiary is entitled. Howbeit, the defining characteristic of a BCA, and what distinguished it from a CEA of any of the kinds noted, is that a BCA measures all inputs and outcomes as monetary values. For brevity, we use the terms “monetary equivalents” or “monetised” to describe the valuations of non-market-traded outcomes so expressed. In principle, however, we might equally think in terms of using another non-monetary unit of account, including an intangible one, such as equity units or utils, or alternatively a tangible one, such as smartphone equivalents. The reasons why BCA invariably uses a monetary-valuation strategy are explained in Section 4.

For the market-traded inputs and outcomes shown in the top row of Table 7, market prices can be used for valuation. For non-market-traded inputs and outcomes, enumerated in the bottom row, non-market prices evidently need to be obtained. To distinguish non-market prices from market ones, the former are called shadow prices by economists<sup>5</sup>. A shadow price is merely the term used to refer to an inferred price applied to a good that is not bought or sold in the market. By extension, the term shadow price refers also to adjusted prices for goods that are inaccurately priced in the market (more on this in Section 4). As we have noted, shadow prices can play a role in any EEH costing study; however, given the thoroughgoing use of monetary valuation in a BCA, shadow prices are a particularly important element required for this type of study. The table of accounts for a typical BCA in health is shown in Table 7. Table 7 differs from Table 4 for a CEA only in its uniform use of prices to express not only all inputs but also all outcomes as monetary values.

5 Shadow price is technically the name for the solution value of a Lagrangian multiplier in the theory of constrained optimization. By analogy, the term shadow price is commonly used in economics to refer to any non-market price estimated by any of a variety of means.

**Table 7:** Generic table of accounts for a typical BCA

	Costs ( $P_s \times Q_s$ )	Benefits ( $P_s \times Q_s$ )
Market-valued costs and benefits	<ul style="list-style-type: none"> <li>• Paid-work costs</li> <li>• Equipment-and-machines costs</li> <li>• Medicines-and-consumables costs</li> <li>• Facilities costs</li> <li>• Other non-healthcare market-traded costs</li> </ul>	<ul style="list-style-type: none"> <li>• Productivity benefits</li> <li>• Labour-supply benefits</li> <li>• Other market-valued benefits</li> </ul>
Non-market-valued costs and benefits	<ul style="list-style-type: none"> <li>• Beneficiaries'-unpaid-work costs</li> <li>• Volunteers'-unpaid-work costs</li> <li>• Other non-market-traded costs</li> </ul>	<ul style="list-style-type: none"> <li>• Increased-years-of-life benefits</li> <li>• Increased health-related-quality-of-life benefits</li> <li>• Other non-market-valued benefits</li> </ul>

## THE STATUS OF PRICES IN AN EEH

Market prices represent the cost, in financial terms, of purchasing the inputs required for the intervention. This is the minimal sense of monetized value that is required for a CEA. However, do market prices also represent something more meaningful, and if so under what conditions? Similarly, are the shadow prices required for an EEH and in particular for a BCA a socially meaningful measure of value? Before discussing these questions more in Section 4, we display the tables of account for several EEHs that are closely related to the BCA study, and we also make some general remarks.

## COST-OF-ILLNESS STUDIES

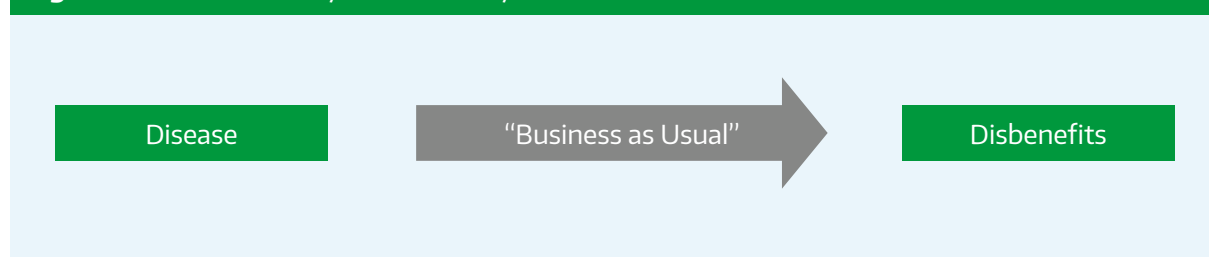
One such study is the cost-of-illness (COI) study. Although COI studies have mostly been superseded in contemporary evaluation research in health, they were popular in the post-war period and figured prominently in the ground-breaking work of Dorothy Rice and Selma Mushkin. At the time, EEHs did not form a distinct sub-field within evaluation science, nor were they sharply separated from the broader domains of economics. For these reasons COI studies are highly instructive today, since they reveal the kind of questions that captured the imagination of the public-sector researchers and policy-makers who codified and applied EEHs in the decades

following Rice and Mushkin. Moreover, COI studies have recently experienced something of a resurgence in global health, arguably related to the demoticization of EEHs, demonstrating that the concerns to which the original COI studies gave voice remain important, in particular for non-specialist audiences.

A COI study purports to measure the economic consequences of illness. At the foundation of the methodology is a distinction between the direct costs of treatment, rehabilitation, or palliation and the indirect costs of outcomes that are the consequential effects of disease, such as reduced labour-force participation. In other words, if a disease might have been prevented, treated, or eliminated but no further action is taken (that is, beyond business as usual), then not only the costs of (baseline) treatment but also the forgone benefits that would have flowed from the (counterfactual) enhanced prevention, treatment, or elimination are counted as costs in a COI study. The causal story of a COI study is hence rather different from that of most EEHs. See Figure 3.

What a COI study calls costs might in our conception of BCA be better termed disbenefits, meaning the negative consequences (outcomes) of not doing more, valued in monetary terms. In practice, the forgone consequential benefits counted in a

**Figure 3:** The causal story of a COI study in schematic form



COI study are invariably market valued, in particular the negative effects of illness on labour productivity and supply. A COI study in effect relabels monetary benefits that might have been achieved through the improved prevention, treatment, or elimination of disease as the indirect costs of doing nothing more than usual. The focus of the COI study is thus on the disease; in the COI study, the disease is the protagonist whereas the intervention is the protagonist of most other forms of EEH. The table of accounts for a typical COI study is shown in Table 8. The concept of disease-focused studies allows us also to make a broader comment.

## DISEASE-FOCUSED STUDIES

Disease-focused studies are usually considered relevant before undertaking intervention-focused studies (at least in the sense that they

are logically prior). Disease-focused studies are suitable for answering agenda-shaping questions (e.g. Is it worth spending billions of dollars in public money to discover a cure for Fields condition since, tragic though it is, there are only two people in the world with the disease?). Another common disease-focused study is the burden-of-disease (BOD) study. A BOD study measures only the non-market-traded, negative outcomes of disease. Neither COI nor BOD alone indicate the potential benefit of interventions, though advocates sometimes use such studies to set research priorities or treatment priorities. Although, like the effectiveness study, a BOD study is not an EEH properly speaking, we show its table of accounts in Table 9. The COI study might be said to be similar in purpose to a BOD study; however, in terms of its focus on monetary valuation the COI study is a close methodological relative of the BCA study.

**Table 8:** Generic table of accounts for a typical cost-of-illness study

	Direct costs of business as usual	Benefits Indirect (consequential) costs of business as usual
Market-valued costs	<ul style="list-style-type: none"> <li>• Paid-work costs</li> <li>• Equipment-and-machines costs</li> <li>• Medicines-and-consumables costs</li> <li>• Facilities costs</li> <li>• Other market-traded costs</li> </ul>	<ul style="list-style-type: none"> <li>• Productivity costs</li> <li>• Labour-supply costs</li> </ul>
Non-market-valued costs	(not assessed)	(not assessed)

**Table 9:** Generic table of accounts for a burden-of-disease study

	Costs of doing nothing for the disease	Bad outcomes of the disease
Market-valued costs	(not assessed)	(not assessed)
Non-market-traded outcomes	(not assessed)	<ul style="list-style-type: none"> <li>• Decreased years of life</li> <li>• Decreased health related quality of life</li> </ul>

## THE INVESTMENT CASE IN HEALTH

Another hybrid EEH now popular in global health is the investment case. Although the term has been used in a number of senses, we restrict our attention to investment cases reporting a return-on-investment (ROI) statistic. Since this is one of the principal statistics usually calculated in a BCA, an investment case is therefore merely the name for a specific kind of BCA. A standard BCA is designed to determine whether any intervention (policy, plan, or project) is socially desirable, where social desirability is decided by an indicator function that compares some aggregate of benefits to costs (see Section 4 for more details). A typical investment case in health employs a table of accounts similar to that shown in Table 10. Here, and in contrast to a standard BCA, non-market-valued benefits are usually restricted to health benefits, and non-market-valued inputs are frequently ignored [e.g. 50]. As in a COI study, moreover, the market-valued benefits counted in an investment case in health are usually restricted to labour-market-mediated outcomes.

### CAUSAL INFERENCE IN EEHS

We claimed that a causal story lies at the heart of any EEH and that it is usually embodied in the effectiveness study. To recap, a simple way

to understand any EEH is that it builds on the causal story by layering additional, specifically economic, information on to the structure of the effectiveness study. In another way, however, the effectiveness study is also key to understanding an EEH: the effectiveness study relies on one of the main methods of scientific enquiry, namely counterfactual analysis. Counterfactual analysis is based on the idea that cause *C* is a cause of event *E* if and only if *E* depends counterfactually on *C*; that is, if and only if *C* had not occurred, *E* would not have occurred [51]. An important technique in empirical analysis using the counterfactual approach is thus to isolate a state of the world in which *C* does not exist, and where *E* too can be reliably observed not to exist, while also isolating a state of the world in which *C* does exist and where *E* too can be reliably determined also to be present: when this can be done, the claim that *C* is the cause of *E* is held not to have been refuted. This strategy is at the heart of modern experimental design, and explains why pains are taken to isolate the control arm from the intervention arm, and thus to segregate intervention inputs within only the intervention arm of, say, a randomized controlled trial. Just as the effectiveness study establishes the conditions allowing for causal inference about the intervention, so must the EEH respect these same conditions if one is to make valid inferences about the corresponding economic facts.

**Table 10:** Generic table of accounts for a typical 'investment case' in health

	Costs ( $P_s \times Q_s$ )	Benefits ( $P_s \times Q_s$ )
Market-valued costs and benefits	<ul style="list-style-type: none"> <li>• Paid-work costs</li> <li>• Equipment-and-machines costs</li> <li>• Medicines-and-consumables costs</li> <li>• Facilities costs</li> <li>• Other market-traded costs</li> </ul>	<ul style="list-style-type: none"> <li>• Productivity benefits</li> <li>• Labour-supply benefits</li> </ul>
Non-market-valued costs and benefits	(not assessed in this example)	<ul style="list-style-type: none"> <li>• Increased-years-of-life benefits</li> <li>• Increased-health-related-quality of life benefits</li> </ul>

Investment cases in health sometimes include a quantity called “averted costs” as one of the benefits of intervention. Averted costs, which are also commonly called “cost offsets”, refer, for example, to the reduced costs required for the treatment of disease following a vaccination campaign. In our framework, healthcare costs incurred prior to the intervention are a feature of the baseline scenario. Clearly, the comparison on which an EEH relies depends on a strict logical separation between the baseline (e.g. actual or current) state of the world used for comparison purposes and the counterfactual (i.e. intervention) one. This is analogous to the separation maintained in a trial between the intervention and the control arms: just as in a trial, in an EEH we compare these two states of the world so as to measure the effect of the intervention.

Isolating the intervention inputs and outcomes in only one of the states of the world is the key to making causal inferences about intervention effects. Nevertheless, in order to compare the baseline and intervention states of the world, we take the difference between the two, i.e. costs in the baseline (or comparator) scenario are subtracted from the costs, including those of the intervention, in the counterfactual scenario, and likewise the effects in the baseline are subtracted from intervention effects in the counterfactual. Baseline costs are then sometimes called “averted costs” and interpreted as a benefit. It should be clear however, that averted costs are not a benefit but rather a quantity that is subtracted from the costs of the intervention: averted costs are a debit on the input-side rather than a credit on the outcome-side of the balance sheet. This distinction is crucial for the implicit logical framework of an EEH.

While subtracting baseline costs from intervention costs is a perfectly valid

accounting procedure, there is another common use for averted costs that is not at all valid, either causally or in accounting terms. Averted costs are commonly used as a surrogate (i.e. as a shadow price) for intervention benefits in an investment case, as shown in Table 11. For example, the (market-valued) costs of cancer treatment in the baseline might be used to estimate the market-valued benefits of preventing the cancer due to an intervention. This usage, however, does not maintain a logical separation between the intervention and baseline scenarios and is thus illegitimate. It is therefore strongly deprecated.

On the other hand, increases in the labour supply due to the prevention of the cancer are a benefit that is causally attributable to the intervention. Increases in the labour supply, for example, valued say at the average wage rate, are an unequivocal market-valued benefit. Likewise, to maintain the separation between states of the world that is necessary for causal inference, it is important not to subtract a market-valued benefit, such as the value of increased labour supply, from the costs of intervention. This point has become obscure, as it is perhaps understandably tempting to lump together inputs and outcomes that are all denominated in monetary units in the numerator of a cost-effectiveness ratio despite the fact that such confounding negates the basis of causal inference.

In summary, it is important to distinguish conceptually between the two common uses of the term “averted costs” and not to be taken in by the fact that the same words are often employed in two distinct usages. The usage shown in Table 11 (we stress, not recommended) is discussed again in Section 4.

### CEAS IN INVESTMENT-CASE CLOTHING

Sometimes the table of accounts used for an investment case in health would, if rendered explicit, look similar to that shown in Table 12. This table of accounts is virtually identical to that of a typical CEA in health (i.e. one comparing market-valued costs to non-market-valued health outcomes), except that here outcomes have been valued in monetary terms. One might well ask, what is the value added of such a study?

Since the price estimates for non-market-valued outcomes, in particular for health outcomes, are subject to a number of principled objections (see Section 4), there would seem to be little purpose in dressing up a CEA as a diminished investment case of this

kind. Indeed, doing so might be considered tantamount to polluting an accepted notion of health outcomes (e.g. HALYs) with a doubtful estimate of the shadow price of health gains (e.g. VSLY, or “value of a statistical life-year”). Consequently, this kind of investment case is also not recommended. An investment case should report at least some market-valued benefits in order to so qualify as such.

So far, we have shown how our table of accounts can be used to lay out the landscape of economic evaluations in health in a systematic way. In the next section we consider how it helps to frame the discussion of a particular form of EEH, namely benefit-cost analysis in health.

**Table 11:** An augmented table of accounts for an alternative investment case (not recommended)

	Costs of the intervention	Benefits of the intervention
Market-valued costs	<ul style="list-style-type: none"> <li>Intervention costs calculated in the usual way</li> </ul>	<ul style="list-style-type: none"> <li>Labour-market benefits calculated in the usual way</li> <li><b>Averted healthcare costs</b> (i.e. those from the upper-left-hand cell in Table 7)</li> </ul>
Non-market-valued costs	(not assessed)	<ul style="list-style-type: none"> <li>Health benefits calculated in the usual way</li> </ul>

**Table 12:** A diminished table of accounts for an investment case in health (not recommended)

	Costs ( $P_s \times Q_s$ )	Benefits ( $P_s \times Q_s$ )
Market-valued costs and benefits	<ul style="list-style-type: none"> <li>Paid-work costs</li> <li>Equipment and machines costs</li> <li>Medicines and consumables costs</li> <li>Facilities costs</li> <li>Other market-traded costs</li> </ul>	(not assessed in this example)
Non-market-valued costs and benefits	(not assessed in this example)	<ul style="list-style-type: none"> <li>Increased years of life benefits</li> <li>Increased health-related quality of life benefits</li> </ul>



## 4. A DETAILED LOOK AT BENEFIT-COST ANALYSIS

In this section we discuss benefit-cost analysis (BCA). Our purpose is to offer an account of BCA that will be useful to those who use, commission and perform EEHs (in particular, “investment cases”) but who are not themselves specialists in the economics of BCA. Our account, however, is also intended to be a critique that will be of interest to BCA practitioners and welfare economists.

### 4.1. WELFARE ECONOMICS

#### INTRODUCTION

Benefit cost-analysis is a part of applied welfare economics insofar as it adopts an approach to measuring benefits that is conventionally termed “welfarist”. Though the welfarist approach has common points with the notion of perspective as discussed so far, it nevertheless differs from it in important ways. So to set the stage for BCA we need first to discuss welfare economics. Doing so has the side benefit of fleshing out a claim we made at the outset: that in the post-war period economic analysis became the predominant mode for the planning, management and evaluation of public social policy.

The welfarist approach is concerned with counting and maximizing benefits enjoyed by individuals. But welfare economics goes further: it relates human well-being (equivalently as “welfare” or “utility”) to the behaviour of individuals, and therefore also relates the implications of market arrangements for human well-being. In its focus on the well-being of individuals, welfare economics responds to one of the chief

concerns of enlightenment thought,<sup>6</sup> and it has moreover been repeatedly recognized as an outstanding contribution to economic theory.<sup>7</sup>

In the theory of welfare economics, the value individuals assign to beneficial outcomes (“benefits”) is usually assumed to be determined by their preferences, although other accounts are possible [52]. Individuals’ preferences are required by the theory to obey certain rules, termed rational [52]. When preferences follow such rules and when, in addition, specific market conditions (described below) apply, it is possible to draw precise conclusions about the desirability of social policies. Koopmans put it like this:

*The idea that perfect competition in some sense achieves efficiency in the maximization of individual satisfactions runs through the whole of classical and neoclassical economic literature. At the time when utility was thought of as both measurable and comparable between different individuals this idea was expressed by attributing to perfect competition the property of maximizing the sum of the*

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6 In giving precedence to the satisfaction of the individual, regardless of social station, classical economics and in particular classical welfare economics implicitly answers one of the criticisms voiced by the Abbé Sieyès (1789) in *Qu'est-ce que le Tiers-Etat*: “The desire for wealth seems to make all the states of Europe into nothing other than immense workshops. ... We are thus compelled to regard the greater part of humanity as nothing other than work machines”. In welfare economics, on the other hand, human beings are ends, not means (cf. Immanuel Kant, *Was ist Aufklärung?*).

7 The Nobel Prize Committee has recognized contributions to welfare economics on 6 out of the 50 occasions that a prize in economics has been awarded; these awards account for 7 out of 81 Nobel laureates in economics: Sen (1998), Mirrlees (1996), Allais (1988), Debreu (1983), Koopmans (1975), Hicks (1972), Arrow (1972).

*utilities of all consumers. This view could not be maintained after interpersonal utility comparisons were questioned. However, Pareto introduced a conceptual refinement that saved the proposition. He suggested that competition brought about a state in comparison to which no consumer's satisfaction can be made higher, within the limitations of available resources and technological know-how, without at the same time lowering at least one other consumer's satisfaction level [53].*

The Paretian approach highlighted by Koopmans brings out a peculiar aspect of the economic theory of efficiency: efficiency is apparently desirable not only in the sense of the maximization of desirable outcomes (i.e. the usual meaning of efficiency) but also in the sense that it does not necessarily require the levelling down of anyone's well-being. This particular aspect of the economic concept of efficiency is termed "Pareto optimality", or "Pareto efficiency". Arrow had this to say about it [10]:

*Both the conditions of this optimality and the definition of optimality call for comment. A definition is just a definition, but when the definiendum is a word already in common use with highly favorable connotations, it is clear that we are really trying to be persuasive; we are implicitly recommending the achievement of optimal states.*

### **DECENTRALIZED DECISION-MAKING: EFFICIENCY, OPTIMALITY AND LIBERTY**

The theory of neoclassical welfare economics developed in the post-war period offered a theoretically rich and mathematically rigorous account of Adam Smith's "invisible hand", which is to say the idea that the decentralized and uncoordinated actions of independent agents result in a state of social organization where benefits are maximized,

where each individual can pursue her well-being according to the means available to her and, importantly, in which the state respects the individual's autonomy.

This theory came in the form of a number of a number of linked results on the equilibrium of competitive markets, results that remain a reference point for nearly all technocratic forms of economic analysis. That said, we refer here only to the main theory bearing on welfare economics [54, 55, 56]. Prior to these contributions, the "new welfare economics"<sup>8</sup> of the pre-war period relied on similar ideas but lacked a rigorous mathematical demonstration. Arrow, Debreu, and others gave welfare economics its mathematical foundation<sup>9</sup> and in so doing firmly established its technical basis. However, they first had to "save the proposition" that markets were both efficient (in the usual sense) and optimal (in the Paretian sense). Although, previously, the notion of optimality had relied on explicit comparisons of well-being across persons, growing scepticism about the scientific basis for such comparisons, based on criticisms elaborated by economists such as Friedrich Hayek, Ludwig von Mises, and Lionel Robbins, required a response. The chief counter-move available in this debate was for welfare economics to adopt henceforth the optimality concept of Pareto [53, 54], which is to say, to abandon the vision of optimality previously embraced.

In the pre-war form, proposed for example by Bergson [57] and Samuelson [58], welfare

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8 Considered to originate in the work of Bergson, Hicks, Hotelling, Kaldor, Lange, Lerner, Samuelson, and Taylor, who expanded on earlier work by Edgeworth, Marshall, Pareto, Pigou, and Sidgwick.

9 Adopting contemporary advances made by George Dantzig and John von Neuman that were an integral part of the post-war efflorescence of management science.



economics assumed that transfers from the wealthy to the poor could be social welfare enhancing provided the rich were not ultimately made poorer than the poor. The basis for this was the diminishing marginal utility of income, and the use, either implicit or explicit, of a utilitarian (i.e. additive in utilities) social welfare function. This concept was referred to as the Pigou-Dalton principle [47]. The pre-war welfare economists believed that interpersonal well-being comparisons such as those required for the Pigou-Dalton principle were an essential part of their theory. Although as noted above that idea had been under attack since the beginning of the century, the most damaging blow was in the end struck by Arrow in the form of his 1951 impossibility theorem [59].

### INTERPERSONAL COMPARISONS AND ARROW'S IMPOSSIBILITY THEOREM

In summary, the battle lines were thus drawn: (i) interpersonal comparisons involve value judgements; (ii) value judgements are unscientific because they rely on an objective theory of the good<sup>10</sup>; and (iii) "such a philosophy could be and was used to justify government by elite, secular or religious" [59]. So to avoid the trap of inadvertently falling into totalitarianism through helping the poor, many economists felt obliged to eschew judgements about whose well-being matters more, such as that contained in the proposition that the poor benefit more from an additional \$100 than the rich suffer from its removal. Arrow showed in effect that, in order to achieve this kind of value neutrality, a social welfare function needed to respect certain conditions. In the impossibility

theorem, moreover, Arrow made what is the most influential claim about what those conditions are. Somewhat unexpectedly perhaps, in doing so Arrow showed that no social welfare function respecting his mooted conditions could be both rational and scientifically neutral in the sense of not requiring "value judgements".

What is not widely appreciated, however, is that, in excluding interpersonal comparisons of well-being like those required for the Pigou-Dalton principle, the third condition of Arrow's impossibility theorem also rules out *intrapersonal* comparisons of differences in well-being [52]. This has the perverse result of ensuring that any social welfare function satisfying Arrow's conditions is absolutely insensitive to the difference between happiness and misery for any given individual. Presumably Arrow did not think of intrapersonal comparisons of differences in well-being, such as those between happiness and misery, as being unreasonable or unscientific *per se*; even Wittgenstein, highly sceptical regarding the possibility of knowing the independent nature of reality, nevertheless maintained that an individual herself was the truest judge of her well-being.<sup>11</sup> Indeed, in the case of Arrow's impossibility theorem the third condition, obviating intrapersonal comparisons of well-being differences, was necessary not for the sake of value neutrality, but rather to ensure rationality: that is, so as not to fall into a so-called "voting paradox".

A voting paradox can arise if, as in some voting systems, weights are assigned to each place on the ballot. If a candidate withdraws from the race after votes are cast, using the

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10 In Arrow's words, "an objective social good defined independently of individual desires"; in contemporary ethics such theories are referred to as "objective list theories" (cf. <https://plato.stanford.edu/entries/well-being/>) or "objective good theories" [52].

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11 "The world of the happy man is a different one from the world of the unhappy man." (*Tractatus Logico-Philosophicus* 6.43)

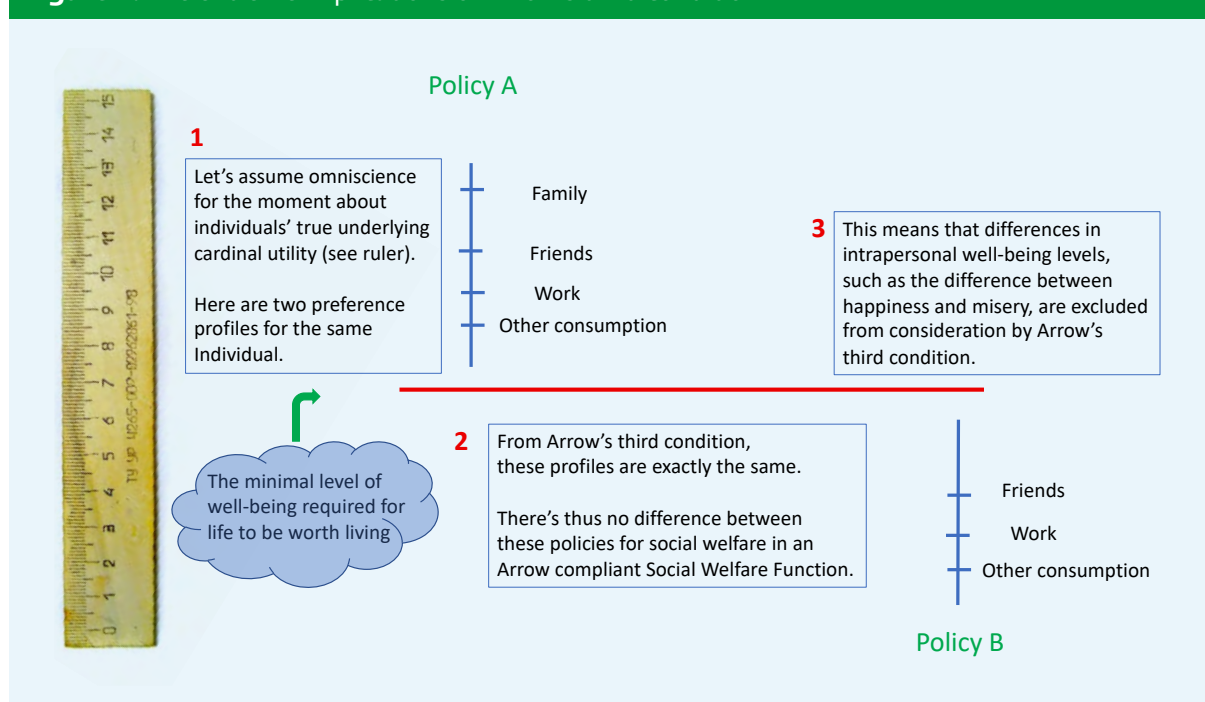
weights previously defined to rank outcomes can produce a result which is demonstrably less preferred by everyone [59] than one of the remaining alternatives. This possibility was forestalled by Arrow's third condition: the "independence of irrelevant alternatives", which limits preferences to rank orderings. Other fixes to the voting paradox might have been possible, such as re-calibrating the weights, but in removing the notion of weights from the social welfare function altogether Arrow chose a solution that could not be subject to the charge of *post hoc* tinkering. While Arrow's third condition preserves rank information from preferences, nothing at all is preserved about differences in the level of satisfaction.

Consequently Arrow's third condition is far more agnostic about well-being than the kind of agnosticism implied by the mere denial of the possibility of interpersonal well-

being comparisons, such as in the subjective theory of value. As claimed above, Arrow's third condition is akin to claiming that the difference between an individual's happiness and misery – however critical that may seem to be for philosophy and in particular for ethics – was simply not a relevant fact for public policy decisions based on a rational concept of social welfare [52] (see Figure 4). Arrow acknowledged that the third condition represented a "value judgement", but it was a value judgement he evidently felt to be entirely warranted [59].

It may ultimately be shown to be the fact of the matter that individuals are themselves incapable of telling the difference between a life of happiness and one of misery, but given the strong intuitions we seem to hold about the criticality of such differences for moral reasoning (cf. Parfit's Repugnant Conclusion), it is extremely striking to discover that these

**Figure 4:** The extreme implications of Arrow's third condition



intuitions must apparently be abandoned by any rational scientific framework for social policy. This fact captures well some of the current disappointment experienced with technocratic approaches to social policy: technocratic approaches seem to many ordinary people to nullify in one fell swoop entire domains of things they care about. Whether this frustration is an intrinsic part of technocracy or rather merely a feature of its post-war form is a question we may explore subsequently.

### THE POST-WAR CONTEXT FOR WELFARE ECONOMICS

Faced with the trio of results on efficiency, optimality and impossibility, welfare economics needed to be reconceptualized as soon as it was formulated in a more rigorous mathematical expression. The principal move was to embrace the concept of Pareto optimality, already discussed. An additional defence was to revive the concept (originating with Kaldor but supported and extended by Hicks) [60, p. 48], of “potential Pareto improvements”. Potential Pareto improvements sidestepped altogether the need to decide whose well-being matters more: the policy-maker can focus purely on efficiency, either by ignoring distributional concerns or by (and presumably this was the idea) passing the buck to a higher authority.

The reluctance to make interpersonal well-being comparisons has been being re-evaluated recently [47, 52]. Yet, at the time, these results on efficiency, optimality and impossibility must have appeared to many economists not only to constitute a robust theory but also perhaps to be the best kind of defence against the statist coercion to which liberal economics claimed to provide an alternative. Modern public economics takes its starting point with the two results

on efficiency and optimality [61, 62]. We shall see below how BCA became an answer to the third one [52].

### THE FEATURES OF MARKET OUTCOMES

We now summarize the main results of neoclassical economics and show their relationship to the field of health economics.

#### *Markets are efficient and optimal – first fundamental theorem*

A **Pareto optimum** is a distribution of goods such that no one in the economy can be made better off without making at least one other person worse off. Pareto optimality implies that all private win-win trades have been made, so we can imagine that the economy is at an equilibrium and that if trades are still continuing they are conducted at equilibrium rates. For example, at a Pareto optimum individuals have sold or are selling as much of their labour, at equilibrium wage rates, as they wish to in order to maximize their well-being. The principle of liberty suggests that no further intervention is warranted since at least one person will be made to suffer and the state should not make choices that involve interpersonal comparisons of well-being. This equilibrium, and the prices that determine it, is called Pareto optimal. The **first theorem of welfare economics** says that any competitive equilibrium, that is, a market outcome resulting from perfect competition, is a Pareto optimum.

#### *Redistribution can be as good as markets – second fundamental theorem*

Although a competitive equilibrium may be Pareto optimal, its distributional features might still be undesirable. This is not far-fetched since extremely unequal distributions can still be Pareto optimal. As the post-war version of welfare economics had

nothing to say about distribution, the (non-economic) value judgements determining more socially desirable distributions needed to be introduced by the policy-maker, or by a higher authority, *deus ex machina*. The **second theorem of welfare economics** says that any desired Pareto-optimal distribution can be achieved by changing prices through a set of taxes and transfers, and that the new Pareto optimum so achieved will also correspond to a competitive equilibrium. Alternatively, for any distribution of income or wealth there is a competitive Pareto-optimal equilibrium. In this way the door was opened for redistributive social policies. We now turn to BCA, which was the main tool available for evaluating the desirability of such policies.

***Potential Pareto improvements – response to the third fundamental theorem on impossibility***

The two fundamental theorems of welfare economics form the bedrock of BCA. However, BCA goes one necessary step further: it claims that changes in which there are winners and losers are permissible if they allow for a greater sum total of benefits. This principle (known as the Kaldor–Hicks condition) implies that it is acceptable for there to be losers who are made worse off for the sake of providing public goods, fixing market failures, or pursuing other policies that improve benefits overall: in other words, redistributive policies should be implemented if it can be shown that they satisfy the Kaldor–Hicks condition. The use of Kaldor–Hicks condition solves the problem of choosing whose welfare matters: losers are acceptable if the sum of gains can potentially compensate the losers' losses. Yet Kaldor–Hicks leaves open the question of how or when compensation will be made, a question beyond the scope of welfare economics. As the Kaldor–Hicks condition is fulfilled when the sum of benefits and disbenefits due to

the policy is greater than the sum of its costs, BCA concludes that a policy is desirable if its benefit-cost ratio is greater than 1. This is the indicator function referred to in Section 3. In using this approach, a rational theory of technocratic social choice could remain agnostic about questions of distribution.

***The neoliberal state in neoclassical economics***

In the neoliberal concept, the state nevertheless retains a key role [55]: to enforce private exchangeable property rights, provide public goods, regulate monopolies, reduce barriers to trade, and repair market failures. Moreover, the best policy tool for financing state functions was, in the light of the first and second fundamental theorems, understood at the time [55, 59] to be the direct taxation of income or wealth (in contrast to indirect taxation in the form of excises on goods and tariffs on trade, the forms of public-sector finance thitherto predominant). These results, expressed in arcane technical language, provided a foundation story for the priestly class of post-war social liberalism<sup>12</sup> [61], which can be summarized as the idea that state-directed public policy (subject to agnosticism about whether and how redistribution should be effected) can and should co-exist within an economy based primarily on individual liberty, private property and the action of free markets.

**THE POST-WAR CONTEXT AND THE BIRTH OF HEALTH ECONOMICS**

Early economists writing about health and healthcare took these neoliberal principles for granted, sometimes more-or-less uncritically [7] but in other cases [5, 10] as a jumping-off point for noting differences in the conditions

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<sup>12</sup> Also called neoliberalism or modern liberalism.

of healthcare markets compared with the assumptions required by welfare economics. Subsequent health economists have tended to move even further beyond the welfarist framing, espousing a view that came to be termed extra-welfarism [63, 64]. Health economics thus formed an important early counterexample to the monolithic vision of social choice in neoliberal economics.

Although the questions investigated in health economics are similar to those of welfare economics (e.g. is policy A superior to policy B?), contemporary health economists are sceptical about several points: (i) that individual preferences are an adequate basis for social choice in health affairs, (ii) that individual choices in healthcare obey the rules of rationality, and (iii) that the market conditions required by the welfare theorems apply [65]. To get around these objections, health economists favour the use of cost-effectiveness analysis in one of its guises (CEA, DCEA, ECEA). Moreover, health economists also tend to eschew grand theories of governance for the public weal. Recently, though, the use of BCA in health has been making a resurgence. In the following, we discuss the merits and demerits of BCA as compared to other forms of EEHs.

## 4.2. DIFFERING ACCOUNTS OF BENEFIT-COST ANALYSIS

Arrow's impossibility theorem revealed the difficulty of rational social choice in the absence of well-being comparisons; it did not, however, obviate the need for making choices. BCA represented a pragmatic approach to decision-making that, with the Kaldor–Hicks condition, could be used while debates about distribution continued. BCA has, moreover, a number of congenial features: it counts

individual benefits, consistent with one of the founding views of enlightenment thought; it takes its bearings from the decentralized action of markets, borrowing strength thereby from the sophisticated mathematics of general equilibrium theory; furthermore, in allowing for intrapersonal comparisons of well-being levels, it violates Arrow's third condition in the least controversial way [52].

Arrow's impossibility theorem questioned whether any programme of rational social choice could be pursued. One of the defining features of rationality was that a transitive ordering of social welfare should be possible under alternative policies, and in common with other forms of consequentialist thought, BCA could not abandon transitivity. In order to maintain transitivity, BCA needed to engineer a set of enabling assumptions [66, p. 37]. According to an authoritative reference guide to BCA, these assumptions are the following:

- i) that individuals' demand for goods is linear in income,
- ii) that individuals' demand curves all have the same slope,
- iii) that there is a unique set of prices faced by all individuals, and
- iv) that individuals can resell any of the benefits resulting from policy.

The latter two assumptions (iii, iv) concern the nature of markets. The former (i, ii) concern the admissible forms of preference satisfaction on the part of individuals (i) and society (ii).

As noted elsewhere [47], BCA is more concerned with pragmatic choices than grand theory. We argue that, while the two assumptions regarding preferences (i, ii) are generally acknowledged as a necessary

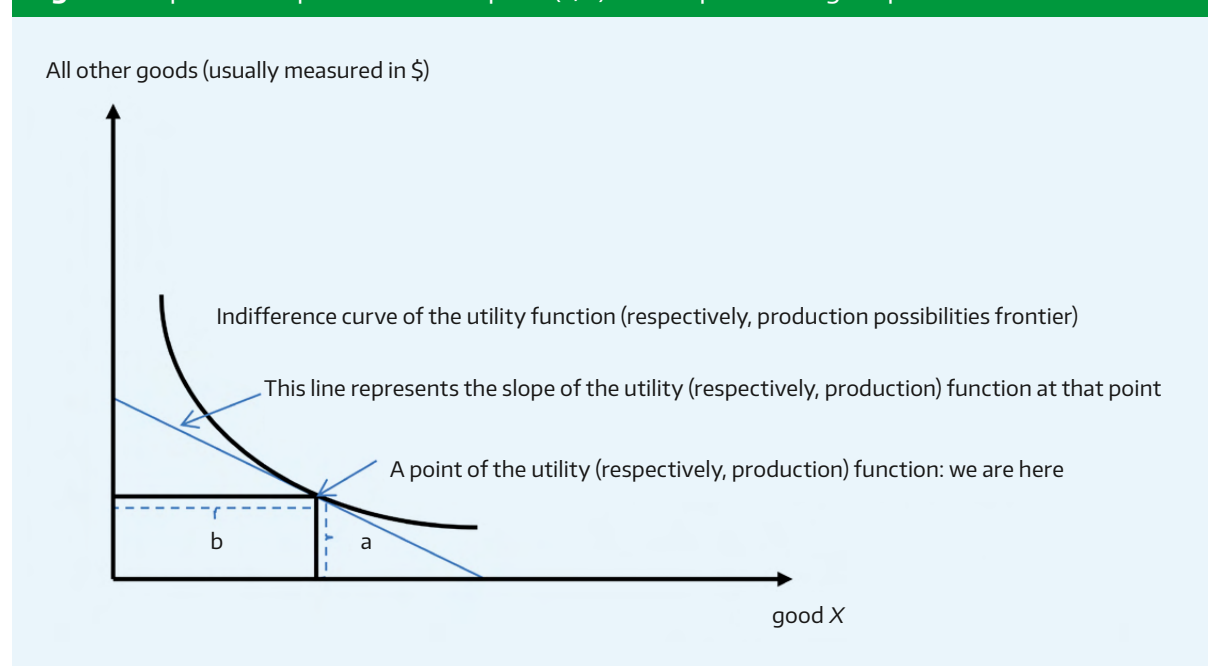
kludge [67] without a basis in fact, the two assumptions about markets (iii, iv) are generally believed to be “true enough” in practice. Differing accounts of BCA exist, though. When framed in terms of the first two fundamental theorems of welfare economics, we term it “macro” BCA; an example is the theory-driven approach of neoclassical public economics [61, 62]. Other accounts posit a more modest foundation, one we term “micro” BCA. In the latter, the fundamental theorems are not mentioned and the optimality of competitive equilibrium is not directly appealed to. In the micro account, Pareto optimality and general-equilibrium theory are vestigial by design; welfare has been replaced by monetary equivalents as the coin of the realm. Accordingly, the basic building block of micro BCA is the concept of “willingness-to-pay” (WTP). Examples of micro BCA are presented in [47, 66, 68, and 69].

Our view is that the micro version relies implicitly on the macro account but without acknowledgement. To show this, we describe what we call the two implicit assumptions of BCA. These implicit assumptions are merely a reformulation and more precise expression of the four conditions mentioned in the micro account presented in [66]. At the risk of some confusion, we name (iii) and (iv) the “first implicit assumption” and (i) and (ii) the “second implicit assumption”, in reverse of the order presented in [66].

### THE FIRST IMPLICIT ASSUMPTION OF BCA – PERFECT AND COMPLETE MARKETS

**There is a unique set of prices faced by all individuals (iii), and individuals can resell the benefits resulting from policies (iv).** Proposition (iii) is equivalent to the assumption of perfect competition, and (iv), to the assumption of complete markets. The first implicit assumption of BCA is therefore

**Figure 5:** A pictorial representation of price ( $a/b$ ) as a slope at a tangent point





that markets are both perfect and complete. General equilibrium theory shows that the market price of a resource (e.g. of good *X*) under perfect competition is the same for all consumers and producers. See Figure 5. In the figure, the slope of the curve at the point (b, a) shows the rate (a/b) at which someone with this utility (respectively, production) function will trade *X* for other goods. Under a competitive equilibrium the (relative) market price is the same for each individual agent as the internal price (marginal rate of substitution) implied by the individual agent's utility (respectively, production) function.

However, only when markets are complete (iv) can individuals resell the benefits of policies. When markets are perfect, such benefits can be sold at a unique set of prices. Take again the example of leisure: if markets are complete and perfect, then individuals can sell as much or as little of their disposable time as they wish, and they will sell up to but not beyond the point where the internal value of leisure equals the external value of labour. In this case not only the prices of market-traded goods (e.g. labour) but also those of non-market-traded goods (e.g. leisure) are unique, ubiquitous and reflect only the aggregate constraints of technology, resources and preferences. This can be stated in another way: when agents face perfect and complete markets their consumption and production decisions are separable.

Separability is equivalent to the decentralization of decision-making, and is held to be one of the chief benefits of perfect and complete markets. The economist Irving Fisher showed that, under these conditions, firms make production and investment decisions that are independent of the consumption decisions of their shareholders (in other words, in the case that the firm's

shareholders happen also to be the firm's managers, the managers have no economic incentive to take actions that would inflate the firm's share price merely for their personal benefit as shareholders; rather, and without any external control, the managers will rationally make decisions to maximize the firm's long-run profits). Under these same conditions, moreover, the members of households and individuals also make separable decisions as consumers of market and non-market goods, on the one hand, and as producers (e.g. sellers of labour), on the other. Unless markets are perfect and complete, individuals can face internal prices (opportunity costs) for non-market goods such as leisure that are not the same as the prevailing wage rate. So the first implicit assumption of BCA also amounts to an assumption of the separability of consumption and production decisions on the part of economic agents.

## THE SECOND IMPLICIT ASSUMPTION OF BCA – MONETARY-EQUIVALENT UTILITARIAN SOCIAL WELFARE

**Individuals' demand for goods is linear in income (i), and all individuals' demand curves have the same slope (ii).** We call this the second implicit assumption since although it is technically necessary for BCA it is not believed to be true. In other words, the second implicit assumption states the requirements that are necessary for the implicit social welfare function of BCA to be rational. The social welfare function particular to BCA might be called a monetary-equivalent utilitarian social welfare function: it requires that monetary equivalents (measures of WTP) be calculated for all goods affected by the policy and then added together for all the individuals who stand to lose or benefit. Practitioners of BCA readily acknowledge that in making these two claims BCA's social welfare function is both unrealistic and

regressive. Nevertheless, they consider that it represents both a reasonable approximation and an acceptable value judgment (some do not consider value judgments to be entailed at all) [70] for the purposes of promoting the objective of efficiency [cf. 67].

### 4.3. BENEFIT-COST ANALYSIS IN PRACTICE

So far we have discussed the theory of BCA. The bulk of its methods, on the other hand, amount to ad-hoc fixes for the sake of estimating monetary equivalents (WTP) in cases where the first assumption required by the theory does not hold, i.e. where market prices do not reflect opportunity cost. Elsewhere, market prices are tacitly assumed in BCA to represent the monetary equivalent of opportunity cost. Even in such cases as market failure and monopoly, however, prices are still assumed to respond to the rational expectations of supply and demand, so there is an assumption that economic methods of demand- and supply-curve inference can be used to estimate surplus value, as well as to estimate the effect of market-shifting changes in the supply or demand of goods, as well as for those of goods in secondary markets. The “economy-wide effects” of policies on all markets together are sometimes estimated using a computed general equilibrium model.<sup>13</sup> In all of these cases observed market prices are filtered, or adjusted, with the aim of representing opportunity costs more accurately. Such adjusted prices are conventionally called shadow prices.

A range of strategies is also employed for estimating the opportunity cost (shadow

price) of non-market goods, i.e. goods for which no market price is available as a starting point. The simplest methods for the shadow-price estimation for non-market goods are based on like-for-like accounting principles, and have been widely used in EEHs since the days of Rice and Mushkin. Like-for-like comparisons mean comparisons in which irrelevant differences (for example, in changing denominators) have been controlled for so that similar things can be appropriately compared. According to the like-for-like principle, the shadow price of a non-market-traded good (like home-making) can usually be estimated by the market price of a relevantly similar market-traded good (like domestic services). It turns out that this like-for-like principle can be applied in at least two distinct ways, described below using the device of our table of accounts.

#### FIRST APPROACH – TRANSPOSE OVER

One like-for-like comparison used to estimate the shadow prices of non-market goods looks at the market prices of inputs to estimate the market prices of similar (counterfactual) outcomes. Transposing prices from inputs to outcomes means in effect copying prices from items in the left-hand column of the table of accounts and pasting them onto relevantly similar items in the right-hand column. See Figure 6. Such outcomes are “non-market-traded goods” here because they have not been realized prior to the intervention and thus represent merely hypothetical goods. Yet, when markets exist for a relevantly similar input, according to the like-for-like principle the input prices can be used to value, *ex ante*, the corresponding counterfactual outcomes. For example, a BCA in health might employ the market prices of paid work (wage rates of labour) in order to estimate the shadow price of increases in the labour supply or in labour productivity attributable to the intervention.

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<sup>13</sup> Not to be confused with the general theory of competitive equilibrium previously discussed.

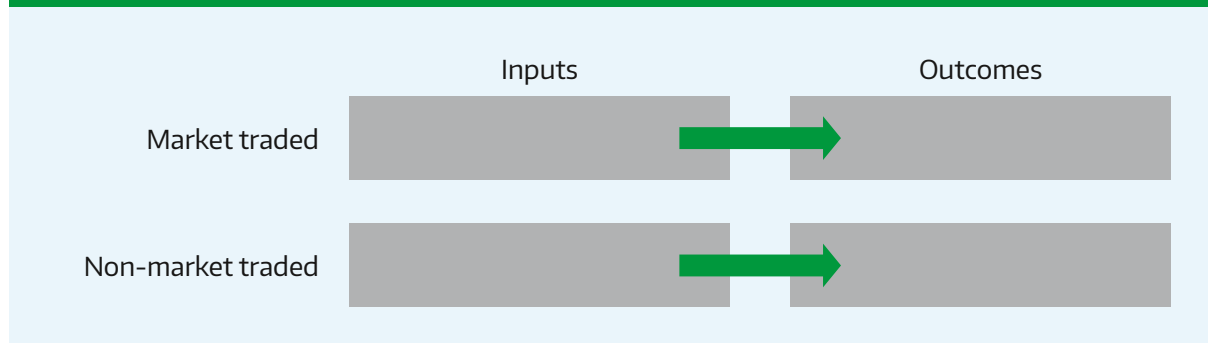


Another example of left-to-right transposition uses the market value of averted healthcare costs (inputs in the baseline scenario) to estimate the shadow price of non-market-traded health gains resulting from the (counterfactual) prevention, treatment, or rehabilitation of the condition. This procedure was previously discussed in Section 3, where it was noted that it violates the logical separation of the baseline and intervention scenarios. We are now see an additional defect of this method: it implicitly claims (but without justification) that the shadow price of non-market-traded health gains can be represented by the indirect costs of forgone labour-market outcomes, such as lost work. In effect this procedure represents a double transposition – *transpose over and then down*. It is doubly not to be recommended.

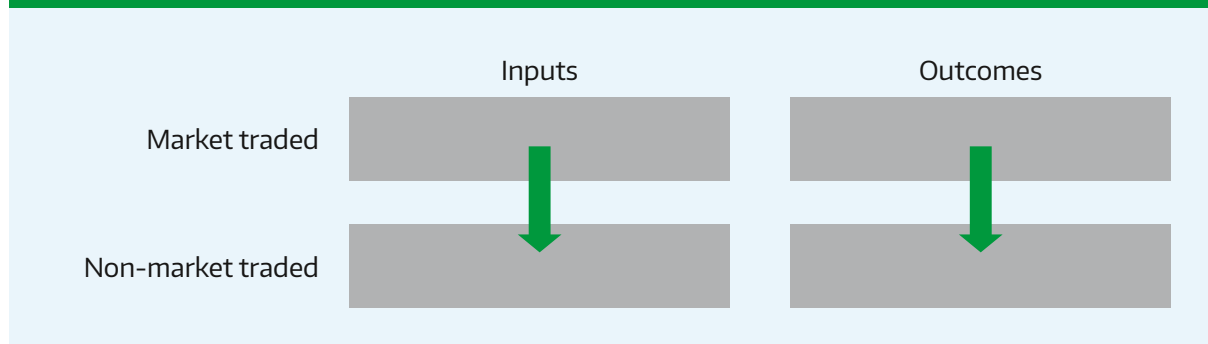
## SECOND APPROACH – TRANSPOSE DOWN

Downward transposition is not in every case illegitimate and another like-for-like comparison that is used to infer the shadow prices of non-market outcomes takes the market prices of market-traded inputs or outcomes in order to estimate the shadow prices of generically similar goods that are not market traded. Transposing prices from market-traded to non-market-traded goods means copying them from items in the upper row of the table of accounts and pasting them onto relevantly similar items in the lower row. See Figure 7. For example, a BCA in health might stipulate that unpaid work (volunteer labour or travel time) can be valued using (some function of) the market wage rate.

**Figure 6:** Pricing outcomes based on similar inputs



**Figure 7:** Pricing non-market-traded resources based on similar market-traded ones



### THIRD APPROACH – PREFERENCE MEASUREMENT

If market prices are not available as a starting point, then monetary equivalents can be estimated *de novo* by means of revealed- or stated-preference studies. This approach is equivalent to eliciting the aggregate demand or supply curve structure directly from individual preference measurements. Reliance on revealed- or stated-preference studies is a critical feature of almost all BCAs done in health, for which one of the main outcomes is a non-market-traded good (i.e. improved health).

The first (*over*) and second (*down*) approaches to shadow pricing rely substantively on the first implicit assumption of BCA (complete and perfect markets). The first implicit assumption justifies the use of market prices for the estimation of the opportunity cost of relevantly similar non-market-traded goods. The third approach, however, takes the first implicit assumption of complete and perfect markets merely as a theoretical reference point and attempts to mimic, through the application of economic theory, the conditions that would pertain were the assumption to hold in practice.

#### *Revealed- and stated-preference estimates of WTP*

The direct estimation of WTP values using revealed- or stated-preference studies relies not only on the first implicit assumption of BCA (i.e. perfect markets); WTP studies also rely on the second implicit assumption of BCA (a monetary-equivalent utilitarian social welfare function [66, p. 37]). Without these assumptions (i, ii, and iii, above), WTP values derived from revealed- or stated-preference studies have questionable economic meaning.

As the name implies, stated-preference studies ask individuals about hypothetical

trade-offs that they would in principle be willing to make; on the other hand, revealed-preference studies rely on the observed features of incomplete markets, or on the collective behaviour of individuals, from which information about the aggregate rates of trade-off between market-valued and non-market-valued goods can be inferred.

In stated-preference studies individuals are asked to make hypothetical trade-offs in isolation from the actions of other economic agents. In the absence of assumptions (i), (ii), and (iii), the data emerging from stated-preference studies can be construed only as constituting potential bids. As such bids have not been subjected to the discipline of the market, although reflecting individual preferences they do not and cannot have any further economic significance unless (i) individuals' demand functions are linear in income, (ii) individuals demand functions have the same slope, and (iii) individuals' hypothetical bids (when averaged in some fashion) represent the market price that would arise through perfect competition.

In revealed-preference studies, on the other hand, some form of collective market forces can be presumed to act, for example when estimates are made of the consumption value of small reductions in mortality risk by looking at wage differentials according to occupation (conventionally called the "value of a statistical life", or VSL). However, in order for estimates from revealed-preference studies of wage differentials to have the force of prices from a competitive equilibrium, it must be assumed that (at least on average and in aggregate) individuals possess complete information about occupational risks, that in making labour-market decisions they act in accordance with the principles of expected utility theory, that they do so independently

of their consumption decisions, and that they are unconstrained by, for example, the market power of employers.

These assumptions are demonstrably false. But that is not the main problem with WTP measures from either revealed- or stated-preference studies. The main problem with WTP measures is that they cannot be aggregated while preserving transitivity in BCA valuations unless the second implicit assumption of BCA (the monetary equivalent utilitarian social welfare) is substantively true. Unless, that is, individuals' demand for goods is linear in income and unless individuals' demand curves have the same slope, aggregate measures of WTP do not respect the principle of transitivity required to preserve rationality in the commonly used sense.

For a BCA done in health, the most important measure of WTP is arguably that required to measure reductions in mortality or morbidity risk occurring as a result of the intervention. Revealed- or stated-preference estimates of the shadow price of health-risk reductions depend on either the first implicit assumption of BCA, or on both assumptions. Failing these conditions, the estimates of WTP derived from revealed- or stated-preference estimates are not socially meaningful (in the sense of the second implicit assumption) and cannot be aggregated into transitive benefit-cost valuations (in the sense of the first implicit assumption). It so happens that if either implicit assumption of BCA is false then both revealed- and stated-preference studies yield estimates of WTP that are not economically meaningful (because they represent a biased estimate of opportunity cost) or are not rational (because they do not preserve transitivity).

#### ***The most serious objection for the use of BCA in health***

Thus, the most serious objection to the use of BCA in health arises with respect to its estimates of monetary equivalents. It either produces estimates which are biased estimates of opportunity cost (in first two approaches, over and down) or estimates that are doubtful as estimates of opportunity cost and in addition are non-transitive (with stated- and revealed-preference approaches). This is important since BCA is often presented as an approach which, although costly and time-consuming to implement, is nevertheless the gold standard for EEH. On the contrary, it is important to understand that BCA contains its own internal contradictions, that there are multiple ways of implementing BCA which are not theoretically equivalent, and that BCA as actually practised diverges in important ways from the logic of economic theory.

## **4.4. OVERALL CONCLUSIONS ABOUT PRICES IN BCAS AND OTHER EEHS**

For BCA, the fact that monetary equivalents do not arise from perfect and complete markets represents an objection in its own terms, i.e. it shows that the claims made by the theoretical underpinnings of BCA are not and cannot be fulfilled in practice. On the other hand, the defects of, in particular, market prices are not a strong objection for EEHs in general and, in particular, are not so for those adopting an extra-welfarist approach such as CEAs, DCEAs and ECEAs, since prices albeit imperfect nevertheless reflect financial opportunity cost for the public-sector decision-maker.

In spite of these objections, BCA holds for some [71] an attractive measurement strategy for EEHs, and BCAs are widely used in non-health domains [68, 69]. So, subject to ambiguity about the meaning of estimates of monetary equivalents, BCA allows for the comparison of health interventions with other public-sector activities (say, at the level of Treasury), and in addition it also provides, through its use of a single unit of account denominated in monetary terms, the benefit of informational compression facilitating the retention and communication of results. For both these reasons BCAs serve a useful purpose in mobilizing political will and in influencing donors and other international actors in health.

## 4.5. THE TABLE OF VALUES IN A BCA

To make the estimates of values explicit in a BCA, we recommend that a **table of values** complementing the table of accounts should be made explicit. Although we have so far shown prices integrated directly into the table of accounts, an explicit table of values for a BCA is a critical methodological element to document, given the difficulties inherent in estimating shadow prices.

In brief, for each of the items listed in the table of accounts, we recommend that the BCA practitioner should indicate the unit price (monetary equivalent) used and document how it was estimated. See Table 13 for example categories where prices should be explicitly justified for a BCA.

**Table 13:** Generic table of values for a BCA in health

	Input values (Ps)	Outcome values (Ps)
Market prices	<ul style="list-style-type: none"> <li>• Paid work costs (e.g. wages)</li> <li>• Equipment and machines unit prices (e.g. rental)</li> <li>• Medicines and consumables unit prices</li> <li>• Facilities unit prices</li> <li>• Other market-traded unit prices</li> </ul>	<ul style="list-style-type: none"> <li>• Productivity prices (e.g. shadow wage differentials for increased productivity)</li> <li>• Labour-supply prices (e.g. shadow wages)</li> <li>• Other non-market outcome prices</li> </ul>
Shadow prices	<ul style="list-style-type: none"> <li>• Beneficiaries' unpaid work shadow prices</li> <li>• Volunteers' unpaid work shadow prices</li> <li>• Other non-market-traded shadow prices</li> </ul>	<ul style="list-style-type: none"> <li>• Increased years of life shadow prices</li> <li>• Increased health-related quality of life shadow prices</li> <li>• Other non-market-valued shadow prices</li> </ul>

## 5. CONCLUSIONS

Investing in health is often a good choice for governments and individuals. However, funders demand evidence in the form of EEHs to help them separate good investments from less good ones. It is tempting to believe that there is a right answer to the question of what makes a good investment in health. However, there are many acceptable ways to answer this question: in this paper, we present a framework for thinking about some of the commonly used ways of capturing and organizing the value for money offered by investments in health. Our aim is not to promote a particular form of EEH but rather to encourage the thoughtful choice of methods within a broadly pluralistic approach. There are clearly trade-offs, however: more complex analyses give (in principle) a more complete picture of the advantages and disadvantages of a course of action, but at the same time they are more difficult and time-consuming to implement and less transparent to lay users; the principle of proportionality demands that the level and style of analysis should be appropriate given the burden of disease and the financial commitment required, but the principle of consistency demands that similar technologies should be analysed in a similar and comparable way.

As unrestrained individual choice in healthcare may lead to a tragedy of the commons, so may undisciplined use of

the technical methods of EEHs result in confusion and loss of credibility for public authorities and other stakeholders. Different health technology assessment agencies in Europe currently approach EEHs in very different ways, with the resulting duplication of effort and expense. These losses are inevitably passed on to the end-users of public services, and an unprincipled divergence in methods also limits opportunities for cross-country learning. Though we don't think an international body or donor should mandate any single form of EEH, we believe that countries and other stakeholders should coordinate better around forms of EEH that can obtain common assent and serve as a basis for best practice.

Recognizing the role of important social value judgments (for example, regarding rationality and interpersonal comparisons), and assessing the realism and acceptability of simplifying assumptions on both the demand and supply sides, might be useful points of departure for anyone wondering which of the various forms of EEH is the one best suited for a particular purpose. EEH technicians need to be able to communicate about these issues and to suggest criteria for the benefit of those not only in parallel co-disciplines but also for decision makers, "observers", and those advising them.

## 6. REFERENCES

1. Rosenberg LJ, Posner LD, Hanley EJ (for Fry Consultants, Inc.). *Project evaluation and the project appraisal reporting system*, Agency for International Development, Washington, DC, 1970 (offprint).
2. Roche C. *Impact assessment for development agencies: learning to value change*, Oxfam, Oxford, 1999.
3. *Glossary of key terms in evaluation and results based management*, OECD, Paris, France, 2002-2009.
4. Pawson R, Tilley N. *Realistic evaluation*, London, SAGE, 1997.
5. Mushkin S. Towards a definition of health economics, *Public Health Reports*, 73:785-793, 1958.
6. Mushkin, Selma J. Health as an Investment. *J. Pol. Econ* 70, 5:129-157. Pt. 2, Supplement (Oct.), 1962.
7. Rice, Dorothy P. *Economic Costs of Cardiovascular Diseases and Cancer, 1962*. The President's Commission on Heart Disease, Cancer and Stroke, Vol. 2 (Feb.), 1965. Health Economics Series No. 5. PHS Publ. No. 947-5, 1965. Washington, D. C.: US Department of Health, Education, and Welfare, PHS, Division of Community Health Services.
8. Rice DP. Estimating the cost of illness, *American Journal of Public Health*, 57(3):424-440, 1967.
9. Fourcade M, Ollion E, Algan Y. The superiority of economists, *Journal of economic perspectives*, 29(1): 89–114.
10. Arrow KJ. Uncertainty and the welfare economics of medical care, *American Economic Review*, 53(5):941-973, 1963.
11. Weisbrod B. Collective-consumption services of individual-consumption goods, *Quarterly Journal of Economics*, 78:471–7, 1964.
12. Feldstein MS. *Economic Analysis for Health Service Efficiency: Econometric Studies of the British National Health Service*, Amsterdam: North-Holland, 1967.

13. Klarman H, Francis J, Rosenthal G. Cost-effectiveness analysis applied to the treatment of chronic renal disease, *Medical Care*, 6:48–64, 1968.
14. Auster RD, Leveson I, Sarachek D. The production of health: an exploratory study, *Journal of Human Resources*, 4:411–36, 1969.
15. Culyer AJ, Lavers RJ, Williams AH, Social indicators: health, *Social Trends*, 2:31–42, 1971.
16. Evans RG. Supplier-induced demand: some empirical evidence and implications, in M. Perlman (ed.), *The Economics of Health and Medical Care*, Basingstoke: Macmillan, pp. 162–73, 1974.
17. Williams AH. Measuring the effectiveness of health care systems, in M. Perlman, (ed.), *The Economics of Health and Medical Care*, Basingstoke: Macmillan, pp. 361–76, 1974.
18. Weinstein MC, Stason WB. Foundations of cost-effectiveness analysis for health and medical practices, *New England Journal of Medicine*, 296: 716–721, 1977.
19. Rosser R, Kind P. A scale of valuations of states of illness: is there a social consensus?, *International Journal of Epidemiology*, 7:347–58, 1978.
20. Cullis JG, West PA. *The Economics of Health: An Introduction*, Oxford: Martin Robertson, 1979.
21. Klarman H. The road to cost-effectiveness analysis. *Milbank Memorial Fund Quarterly/Health and Society*, 60(4):585–603, 1982.
22. United States Congress Office of Technology Assessment. *The Implications of Cost-Effectiveness Analysis of Medical Technology*, Washington, DC, 1980.
23. Drummond MF. *Principles of economic appraisal in health care*, Oxford University Press, 1980.
24. Canadian Coordinating Office for Health Technology Assessment. *Guidelines for economic evaluation of pharmaceuticals*, Ottawa, Canada: Canadian Coordinating Office for Health Technology Assessment, 1994.
25. Drummond M, O'Brien B, Stoddart G, et al. *Methods for the Economic Evaluation of Health Care Programmes*, Oxford University Press, 1987.
26. Gold M, Siegel J, Russell L, et al. *Cost-effectiveness in Health and Medicine*. New York & Oxford: Oxford University Press, 1996.



27. World Health Organization. *Guide to Cost-Effectiveness Analysis*, Geneva: World Health Organization, 2003.
28. Wilkinson T, Sculpher MJ, Claxton K, et al. The International Decision Support Initiative Reference Case for Economic Evaluation: An Aid to Thought. *Value Health*, 2016; 19: 921-928.
29. Morton, A., Arulselvan, A., Thomas, R. (2018) Allocation rules for Global Donors. *Journal of Health Economics*. 58:67-75.
30. Morton A., Thomas R., Smith P. C. (2016) Decision rules for allocation of finances to health systems strengthening. *Journal of Health Economics*. 49: 97-108.
31. Morton A (2014) Aversion to health inequalities in healthcare prioritisation: a multiobjective mathematical programming perspective. *Journal of Health Economics*. 36: 164-173.
32. van Baal PH, Morton A, Severens JL. Health care input constraints and cost effectiveness analysis decision rules. *Social Science and Medicine*, 2018;200:59–64.
33. Lauer JA, Bertram M, Morton A. Cost-Effectiveness Analysis. In: Global Health Priority-Setting Beyond Cost-Effectiveness. Edited by Norheim OF, Emanuel EJ, and Millum J. Oxford University Press, 2019.
34. Koplan et al. Towards a common definition of global health, *Lancet*, 373, 2009.
35. Daniels N. Accountability for reasonableness: Establishing a fair process for priority setting is easier than agreeing on principles. *BMJ*, 2000 Nov 25; 321: 1300–1301.
36. Neumann PJ, Willke RJ, Garrison LP. A health economics approach to US value assessment frameworks—introduction: an ISPOR Special Task Force report[1]. *Value Health* 2018;21:119–23.
37. Garrison LP, Neuman PJ, Wilke RJ. A health economics approach to US value assessment frameworks: summary and recommendations of the ISPOR Task Force reports [7]. *Value Health* 2018;21:161–5.
38. Sculpher M. ISPOR's Initiative on US Value Assessment Frameworks: Seeking a Role for Health Economics, *Value Health* 2018;21:171–2.
39. Peretto EM. ISPOR's Initiative on US Value Assessment Frameworks: A Missed Opportunity for ISPOR and Patients, *Value Health* 2018;21:169–170.
40. Burkholder R, Dougherty JS, Neves LA. ISPOR's Initiative on US Value Assessment Frameworks: An Industry Perspective, *Value Health* 2018;21:173–175.

41. Chesbrough H, Rosenbloom RS. The role of the business model in capturing value from innovation: Evidence from Xerox Corporation's technology spin-off companies. *Industrial and Corporate Change*, 2002, 11:529-555.
42. Lehoux P, Miller FA, Daudelin G, Denis JL. Providing Value to New Health Technology: The Early Contribution of Entrepreneurs, Investors, and Regulatory Agencies. *Int J Health Policy Manag*. 2017 Jan 25;6(9):509-518.
43. Buttigieg SC, Hoof JV. The Conceptualization of Value in the Value Proposition of New Health Technologies Comment on "Providing Value to New Health Technology: The Early Contribution of Entrepreneurs, Investors, and Regulatory Agencies". *Int J Health Policy Manag*. 2017 Jul 3;7(2):186-188.
44. Parvizi N, Parvizi S. New Health Technologies: A UK Perspective Comment on "Providing Value to New Health Technology: The Early Contribution of Entrepreneurs, Investors, and Regulatory Agencies". *Int J Health Policy Manag*. 2017 May 9;6(12):721-722.
45. Greenhalgh T, Fahy N, Shaw S. The Bright Elusive Butterfly of Value in Health Technology Development Comment on "Providing Value to New Health Technology: The Early Contribution of Entrepreneurs, Investors, and Regulatory Agencies". *Int J Health Policy Manag*. 2017 May 29;7(1):81-85.
46. Husereau D, Drummond M, Petrou S, Carswell C, Moher D, Greenberg D, Augustovski F, Briggs AH, Mauskopf J, Loder E, on behalf of the CHEERS Task Force. Consolidated Health Economic Evaluation Reporting Standards (CHEERS) statement, *BMJ*. 2013;346:f1049 (Published 25 March 2013).
47. Adler MD. *Well-Being and Fair Distribution: Beyond Cost-Benefit Analysis*, Oxford, 2012.
48. Cookson R, Mirelman AJ, Griffin S, Asaria M, Dawkins B, Norheim OF, Verguet S, Culyer AJ, Using cost-effectiveness analysis to address equity concerns, *Value Health*, 2017, 20: 206-212.
49. Verguet S, Laxminarayan R, Jamison DT. Universal public finance of tuberculosis treatment in India: an extended cost-effectiveness analysis. *Health Econ*, 2015; 24:318–332.
50. *A healthier humanity: the WHO investment case*. Geneva: World Health Organization; 2018 (WHO/DGO/CRM/18.2).
51. Collins J, Hall N, Paul LA (eds.). *Causation and counterfactuals*, A Bradford Book (Representation and Mind series), Massachusetts Institute of Technology, 2004.
52. Adler MD. *Measuring social welfare: an introduction*, Oxford University Press, 2019.

53. Koopmans TC. *Three Essays on the State of Economic Science*, New York, McGraw–Hill, 1957.
54. Arrow KJ. An extension of the basic theorems of classical welfare economics. *Proc. Second Berkeley Symp. on Math. Statist. and Prob.*, Univ. of Calif. Press, 507-532, 1951.
55. Debreu G. The coefficient of resource utilization, *Econometrica*, 19(3):273-292, 1951.
56. Debreu G. Valuation equilibrium and Pareto Optimum, *Proc Natl Acad Sci USA*, Jul; 40(7): 588–592, 1954.
57. Bergson A. A Reformulation of Certain Aspects of Welfare Economics, *Quarterly Journal of Economics*, 52(2): 310-34, 1938.
58. Samuelson PA. *Foundations of Economic Analysis*, Harvard University Press, 1947.
59. Arrow KJ. A Difficulty in the Concept of Social Welfare, *The Journal of Political Economy*, 58(4): 328–346, 1950.
60. Ng Y-K. *Welfare economics: towards a more complete analysis*, Basingstoke, Palgrave Macmillan, 2004.
61. Laffont J-J. *Fundamentals of public economics* (Bonin JP, Bonin H, trans.), MIT Press, 1988.
62. Rosen HS, Gayer T. *Public Finance* (The McGraw-Hill Series in Economics), McGraw-Hill Education, 2013.
63. Culyer AJ. The normative economics of health care finance and provision, *Oxford Review of Economic Policy*, 5(1):34-58, 1989.
64. Brouwer WBF, Culyer AJ, Job N, van Exel A, Rutten FFH. Welfarism vs. extra-welfarism, *Journal of Health Economics*, 27:325–338, 2008.
65. Culyer AJ, Chalkidou K. Economic Evaluation for Health Investments En Route to Universal Health Coverage: Cost-Benefit Analysis or Cost-Effectiveness Analysis? *Value health*, 22(1):99-103, 2019.
66. Boardman AE, Greenberg DH, Vining AR, Weimer DL. *Cost-Benefit Analysis: Concepts and Practice* (5th ed.), Cambridge University Press, 2018.
67. Robinson LA, Hammitt JK, Cecchini M, Chalkidou K, Claxton C, Cropper M, Hoang-Vu Eozenou P, de Ferranti D, Deolalikar AB, Guanais F, Jamison DT, Kwon S, Lauer JA, O’Keeffe L, Walker D, Whittington D, Wilkinson T, Wilson D, Wong B. *Reference Case Guidelines for Benefit-Cost Analysis in Global Health and Development*. Boston, Harvard T.H. Chan School of Public Health, 2019.

68. *Guidelines for Preparing Economic Analyses*, National Center for Environmental Economics, Office of Policy, U.S. Environmental Protection Agency, December 17, 2010 (updated May 2014).
69. *Guidelines for Regulatory Impact Analysis*, 2016, Office of the Assistant Secretary for Planning and Evaluation, U.S. Department of Health and Human Services, 2016.
70. Culyer AJ, Evans RG. Mark Pauly on welfare economics: normative rabbits from positive hats, *Journal of Health Economics*, 15:243-251, 1996.
71. Robinson L, Hammitt J. Behavioral Economics and the Conduct of Benefit-Cost Analysis: Towards Principles and Standards, *J Benefit-Cost Analysis*, 2:1-51, 2011.



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